

# Aviation Week

and *Space Technology*

December 5, 1960

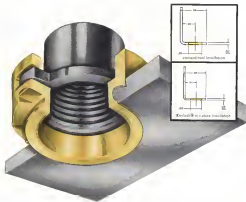
Special Report  
On German  
Industry

75 Cents

A McGraw-Hill Publication



Bell D-188A V/STOL Mockup



## No mistaking Kaynar's new stake nut—it's miniaturized

The new Kaylock® Miniature Stake Nuts bear the unmistakable mark of Kaynar's leadership in aerospace fastener weight and space savings. These new miniatures answer the critical need for installed reliability of threaded elements in minimum thickness materials... can save you up to 30% of hardware weight. Additional savings can accrue as a result of thinner parent material requirements (.008 maximum thickness for Kaylock Non-Flanging Stake Nuts, .048 maximum for Flanging Stake Nuts.)

**Easier and Quicker to Install!** No fitting of the nut shank is required! The pressure used in installation results in a cold flow of the parent material. Then interlock of the nut and the mating material, in a smaller installation hole, provides greater structural integrity. Staking action of the Kaylock self-locking nut provides maximum retention against push-out and torque-out. The new series is available in miniature and regular configurations, both flanging and non-flanging! Write today for the new Kaylock Stake Nut Brochure, or contact your Kaynar representative.

**Kaylock.**

*Just in lightweight locknuts*

KAYNAR MFG. CO., INC. KAYLOCK DIVISION  
Box 1001, Terminal Avenue, Erie, Pa. 16595. Branch offices,  
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Atlanta, Ga.; Kansas City, Missouri; Dallas, Texas; Los Angeles, Calif.



SK 2000 Flanging miniature

SK 2200 nonflanging miniature

## GROUND SUPPORT EQUIPMENT: another prime capability of Goodyear Aircraft



1. Control Programmer/Indicator—new concept for universal test equipment for engines, fuel or APU

2. Pinch Assembly fixture "fixes" elastic seals and hoses in place on engine or turbine



3. Component fixture—holds light weight, small size variety of components for test

## Standardizing G.S.E.? It's Standard Operating Procedure at GAC.

Design philosophy which insists on reducing the number of units to meet the support requirements for such new system as Standard Operating Procedure at Goodyear Aircraft? Shown here are examples of GAC built ground support equipment which benefits from this standardization approach. Besides the requirements are, each unit has been developed to perform the functions of many units. If you are interested in reducing the problems of logistics on your GSE requirements, let us find the common denominator. Write Goodyear Aircraft Corporation, Dept. 615A, Akron 15, Ohio or: Litchfield Park, Arizona.

Lots of good things come from

**GOOD YEAR**  
**AIRCRAFT**

Providing all 2  
ground support units for

ONLINE

MANUFACTURING  
MANAGEMENT



4. Preprocessor Power Pack supplies all Litchfield power needs...a compact power source and engine and fuel system

5. Mobile Jetty Beaming Work...effectively reduces maintenance required for ground handling





SOMETHING NEW  
UNDER THE STARS

The one helicopter FAA-certificated for instrument flight: Cessna CH-1C. First helicopter to meet the existing IFR requirements of FAA, the CH-1C is practical not only for what it does but for how it does it. Through clean configuration—plus its simple mechanical stabilizations—the CH-1C combines low vertical cost, low spilling cost, ease of operation. Now helicopter instrument training and all-visibility flights at last can be considered economical.

**Cessna**  
Military  
Division

WICHTA, KANSAS



World's most experienced makers of utility military aircraft

## AVIATION CALENDAR

(Continued from page 5)

- Nov. 20**—N. Y. House Night Dinner, New York, N. Y.
- Feb. 1**—Eastern Winter Airlines 50th Anniversary Dinner, New York, N. Y.
- Feb. 1**—Hotel Proprietary Conference, American Hotel Society, New York City.
- Feb. 15-16**—International Solid State Conference, University of Rhode Island, Providence, Rhode Island.
- Mar. 1**—World's Annual Car, Truck, Camper and Cablot, American Society of Mechanical Engineers, Sheraton Hotel, Washington, D. C.
- Mar. 8-10**—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.
- Mar. 8-10**—Flight Propulsion Meeting, in conjunction with 8th International Symposium, Cleveland, Ohio (standalone).
- Mar. 12-15**—Aviation Conference, American Society of Mechanical Engineers, Sheraton Hotel, Los Angeles, Calif.
- Mar. 15-15**—Flight Training Conference, American Rocket Society, Los Angeles.
- Mar. 15-16**—Fuel, Operations and Support Conference, American Rocket Society, Sheraton Hotel, Los Angeles, Calif.
- Mar. 16-18**—19th National Conference on Aviation Electronics, Sheraton Hotel, Washington, D. C.
- Mar. 18-23**—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.
- Mar. 20-24**—1961 Western Wild Exposition, American Society for World Peace, Pacific Auditorium, Los Angeles, Calif.
- Apr. 6-8**—National Symposium on Electronics and Fluid Dynamics of Gases, Princeton, Princeton University, Princeton, New Jersey.
- Apr. 15-17**—Life Science Vehicle Symposium, Motorola & Boeing American Rocket Society, Palm Springs, Calif.
- Apr. 27-28**—19th Technical Conference, International Air Transport Association, Queen Elizabeth Hotel, Montreal, Canada.
- Apr. 28**—Symposium on Chemical Reactions in the Liquid and Vapor States, Stanford Research Institute, Menlo Park, California.
- Apr. 29-30**—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.
- Apr. 30**—30th Annual Meeting, Propellers and Composites Association, American Rocket Society, Palm Beach, Florida.
- Apr. 30**—19th Annual Meeting, American Society of Naval Engineers, Sheraton Hotel, Washington, D. C.
- May 1-3**—National Symposium on Electronic Aspects of Space, Sheraton Hotel, Washington, D. C.
- May 1-3**—Western Joint Computer Conference and 19th Southern Hotel, Los Angeles, Calif.
- May 23-24**—National Telecommunications Conference, Sheraton Hotel, Chicago, Ill.
- May 25-26**—4th-19th French Symposium on Space, La Reunion, French Equatorial Africa.
- Sept. 4-10**—1961 Flight Display and Exhibition, Scripps Ranch, San Diego, California.



## Raytheon Fire Control Radar System installed in newest missile destroyer

Raytheon AN/SPG-51 fire control radar are operational aboard the U.S.S. CHARLES F. ADAMS (DDG-2). As the Mark 71 Fire Control Systems Coordinator for the Bureau of Naval Weapons, Raytheon is carrying out serial production of the advanced design AN/SPG-51.

The ADAMS, first destroyer built from the keel up to launch guided missiles, carries out its Anti-Air Warfare mission with TARTAR surface-to-air missiles. The radar tracks intruders and guides the missile even to low altitude targets despite the use of evasive tactics or electronic countermeasures.

Each AN/SPG-51 consists of a single dish tracking and guidance radar. The radar tracks at long ranges with exceptionally low power.

Upon engagement, AN/SPG-51 automatically acquires and tracks the target. Seconds before missile launch, the target is illuminated with a guidance beam. The missile homes on the reflected signal.

The AN/SPG-51 features excellent sea-clutter stability and exceptional techniques to avoid jamming. Selected by the Bureau of Naval Weapons for guided missile applications, this is the first fire control radar of its type to be produced in quantity.

**RAYTHEON**

**RAYTHEON COMPANY**

EQUIPMENT DIVISION



## BRUNSWICK OFFERS COMPLETE CAPABILITY FOR AEROSPACE PROJECTS

"Complete capability" sums up Brunswick's ability to produce products at any stage of model development. From in-house design and production to thorough testing, Brunswick brings to each new job a vast background in successful development of components and primary structures. **1. In new areas and refinements**, Brunswick designs and materials can be tailored to meet rigorous new requirements for high temperature electrical and ablative purposes. **2. In wings and fins**, Brunswick engineering allows new plastic structures and antennas utilized in combination for more de-

sign freedom with maximum efficiency. **3. Missile bodies** constructed by the Strickland "W" fiber glass filament-winding process offer exceptional values in weight-strength ratios while meeting design requirements for unusual shapes and sizes. **4. Brunswick radial motor cases** constructed by the Strickland "W" fiber glass filament-winding process consistently demonstrate superior properties, whether large or small. Pressure vessels designed by Brunswick can deliver an S/D ratio as high as 2,000,000. **5. Radiators** of metal honeycomb or plastic construction are designed and man-

ufactured to meet close tolerances and conform to the highest standards of quality and performance. **6. Ground radomes** are readily available for ground support applications. Constructed of solid laminate, honeycomb core, or foam, they are standard production design at Brunswick. From the starting line, or at any stage of the development race, Brunswick's complete capability is ready to make your ideas work faster and better. Call on Brunswick's ability to produce results. Brunswick Corporation, Defense Products Division, 1700 Mosler Street, Muskegon, Michigan.

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**Features...** pin-to-pin ratings through 45 kv d.c., or 35 kv pulsed d.c. Performance tested at -55°C under conditions of humidity, shock, vibration and salt spray without functional impairment. Bulkhead pressure-tested to withstand 75 psi.

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**OTHER CONNECTORS FOR CABLE ASSEMBLIES:** TRIAXIAL • Hi Current, Low Voltage, Attenuated Noise Reduction • COAXIAL • Hi Voltage, Low Current, Cross Pairs • STANDARD RIGID TYPES • SPECIAL CABLE ASSEMBLIES

More than 50 years in research in cable assembly noise and control problems.

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## 412L Strengthens Air Defense By Integrating Airspace Management

Rapid coordination of all phases of military airspace management is a major problem of air defense. This automated operations room depicts the heart of the Air Force's 412L Air Weapons Control System—a single, semi-automatic electronic complex which coordinates radar stations, data processing and display centers and weapons bases into a unified network.

Within seconds, 412L will provide the vital detection and tracking data to human decision makers. Precious time will be gained since com-

putations leading up to the final decisions will be done automatically. In addition, 412L is a highly flexible system designed for use throughout the Free World. It will operate in mobile as well as fixed environments.

Currently going into prototype production, 412L has already anticipated technological advances. And, importantly, new equipment can be integrated into this versatile Air Weapons Control System in the future, assuring a complex which will remain combat-ready for many years.

10001

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Microstructure of Treated A-766 showing Ti compound inclusions in Air Melt (bottom) and absence of Ti compound in Vacuum Melt (top).

## BETTER, CLEANER, MORE WORKABLE STEELS through A-L Vacuum Melting Techniques

*What you can expect from A-L's Consmode,<sup>®</sup> Invac, and Invacutrode steels and alloys.*

If you have really critical applications, you need A-L's Consmode, Invac, and Invacutrode steels and alloys, products of unique vacuum melting operations. These alloys provide a combination of improved metallurgical and mechanical properties. They give you the ultrason in complex high-temperature steels and alloys superalloys — provide the finest bearing steels, low alloy steels, stainless steels, tool steels — meet the most critical applications — withstand the worst service conditions.

Here are a few of the specific advantages you get at A-L's vacuum melted materials:

- ✓ Higher mechanical properties—fatigue strength, transverse ductility, toughness
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A-L's modern melting techniques can be applied to help solve your problems. And these vacuum melted steels are in regular production, available now in all commercial mill forms and sizes.

For further information on A-L's modern melting techniques and the advantages of Consmode, Invac, and Invacutrode alloys, get the new booklet, "Modern Melting at Allegheny Ludlum." It's packed with engineering data. Ask your nearest A-L sales office for a copy, or write: Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. AF-12.



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## NEW TELEMETRY TECHNIQUE:



# PCM ON A SUBCARRIER

Compatible with existing FM FM systems. Digital modulation of subcarrier provides increased accuracy and rapid data reduction capabilities. Up to 10 bits transmitted on a 70 KC subcarrier. Subcarriers and Discriminators to 300 KC available for increased frequency response. **VECTOR** Manufacturing Company Inc., Southampton, Pennsylvania.



TELEMETRY COMPONENTS AND SYSTEMS





#### A. First Stage.

The first stage sends thrust data back to the vehicle to separate its signals from the guidance system in the third stage. This control is accomplished by means of its vision located behind the nozzle and by aerodynamic forces which become effective toward the end of first stage operation. A variable displacement hydraulic pump in the first stage supplies the control system for the guidance and aerodynamic systems which are mounted on a common shank. A first stage battery supply provides power for the hydraulic pump assembly. A programmer in the third stage controls first stage separation, time delay, and control stage ignition. Honeywell provides the three main systems: third stage guidance system, hydraulic pump assembly, battery supply and third stage programmer.

#### B. Second Stage.

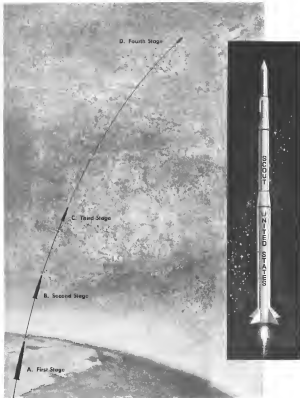
The Honeywell reference system and programmer in the third stage send command signals to the second stage in control of attitude, separation from third stage, and third stage guidance. Second stage attitude control is accomplished by means of an 8 nozzle hydraulic attitude control system.

#### C. Third Stage.

Third stage attitude control is accomplished by means of a two level attitude hydraulic attitude control system. The Honeywell third stage control to attitude reference system and programmer provide command signals to switch between the second stage attitude control. This reference system and programmer also control third stage separation and fourth stage ignition. This third stage also contains integrated Honeywell electronic components plus battery supply and programmer. The attitude reference system and programmer can be slaved to provide attitude of varying altitudes and efficiency or can be programmed for various types of high altitude probe mission.

#### D. Fourth Stage.

In the basic Scout configuration the fourth stage is issued by its rocket to 100 gpm gas to separation from the third stage and guidance. For other missions the Scout vehicle will include fourth stage substitution by means of a Honeywell attitude reference package located in the fourth stage.



## The ABC's of SCOUT

**Honeywell provides complete control system integration for unique new NASA "workhorse" space vehicle**

The new NASA Scout, just now making its first penetration into space, joins the U-2 as a multi-purpose vehicle serving simplicity, reliability and economy. The Scout has been fired twice since July 1, and according to NASA, "guidance and control systems performed satisfactorily on both flights."

To eliminate the flexibility and, therefore, the control problems involved in this Scout program, consider that this solid fuel propelled vehicle is designed for a variety of space missions, placing payloads into these orbits: 80 lbs. at 500 mile orbit, 100 lbs. at 300 mile orbit, and 150 lbs. at 180 mile orbit.

Honeywell engineers analyzed these problems and created a new lightweight, reliable control system that provides the flexibility required for this wide range of missions.

The system uses three orthogonally mounted precision miniature integrating gyros providing control of pitch, roll and heading. The gyros receive precise tracking commands from the mission programmer to change the vehicle course in compliance with the desired mission path.

With this method of attitude control, gross attitude flexibility is obtained through simple changes in reference and timing networks.

Honeywell's system analysis of the vehicle requirements also dictated the selection of hydraulic actuated jet valve and aerodynamic controls for the first stage. Hydraulic attitude reference system were selected by Honeywell systems specialists for second and third stage control.

Honeywell backs Scout's guidance and control system with complete ground support equipment for servicing, checkout and launch.

The Scout guidance system program is only one of many in which Honeywell has proven its "quick action" system analysis, and design abilities. Other programs include Thor, Delta, Discoverer, and Pioneer-Henry. To learn how Honeywell can help solve your system design and integration problems, contact your nearest Honeywell representative, or write Honeywell, Military Products Group, Manufacturing 8, Menlo Park.

#### Engineers and Scientists

Explore the professional opportunities at Honeywell.

## Honeywell

**H** Military Products Group

December 5, 1968

### He solved this puzzle by taking it apart!



Like all and more, extreme precision and "complete" quality level combination in tracking radar systems. Designing for use of closed-circuitry on "automatically" produced the other. That was this AMP Engineer's pass—in put both precision and mobility in an antenna for duty with the Marine Corps.

He solved the puzzle, literally, by taking apart the antenna—AMP's TPO-20—into 28 rugged, portable, interchangeable, precision-fabricated packages. TPO-20 is designed for helicopter transport. Each component can be dropped in water; it will come up for more. The packaged antenna on its pallet can be dropped on land from 3 feet without injurious possibility.

Each component can be picked up—the largest weighs 425 lb.—and can be handled by 3 men. A crew of 6 can put TPO-20 together in 20 minutes with one standard wrench.

Among the design innovations that solved the puzzle is a "pinger-back" gear arrangement that puts both azimuth and elevation dials in one package. Result: almost half the parts and weight of separate components. Precision fabrication is typified by the reflexive arm, held in a .005" deviation over 48 inches!

(For extended information on early tracking and control systems, write Dept. CS-1, address below.)

#### Single Command Concept

Solving radar with zero-to-infinity conditions is AMP's banner. AMP's integration and skills are organized in a single operational unit, offering a wide range of engineering and production capabilities. It accepts assignments at any stage from concept through development, production and service training, and completes them faster—in.

- Ground Support Equipment
- Weapons/Systems/Undersea Warfare
- Airborne Warning & Processing
- Radar Instruments & Radar
- Space Environment Equipment
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## EDITORIAL

### Changing Complexion of Space

Space technology in this country is poised on the brink of major technical and political changes that will radically alter its complexion during the next few years. These changes will have enormous impact for the American people as a nation and specifically for the aerospace industry, as well as the burden of maintaining our technical edge will fall.

This industry faces the prospect of another period of searching with its perennial problems of re-evaluating technical changes combined with expanding requirements. An expanding aerospace market for exploration, research and for military and commercial operational space systems is not visible on the near horizon. The market is at a magnitude that would have been labeled "clear lunacy" if it had been seriously predicted even a few years ago.

These technical and political changes are emerging in an atmosphere that is still heavily conditioned by the continuing success (despite its gravely concealed failures) of the Soviet space program. The recent Soviet two of orbiting capsules containing life support systems offer clear warning that Project Mercury is still waging a long-term chase in the race to put the first human being into orbit and recover them alive—the first milestone in man's eventual development of space as a useful environment.

The Soviet Sputnik VI (see p. 38) is probably one of the last scientific penetration works in the Russian program aimed at putting a two-man orbiting, recoverable space capsule into operation. This effort must be viewed in preparation to the current problems of Project Mercury in checking out complete systems operations, and it certainly presents a radically different and perhaps even inherently sounder approach to the goal of man in space than the Mercury program. If subsequent events prove that these valid and the evidence should be available before the end of next year—it will indeed be a bitter pill for the country, and particularly for the National Aeronautics and Space Administration scientists and political advisors who originally encouraged the Mercury program and delivered it as the key U.S. space program.

#### The Approaching Assault

But NASA will not have to wait for the success or failure of Mercury versus its Soviet competitors to get the first shock of an external public assault on its present position as the premier custodian of the U.S. space program. The character and scope of this assault have been revealed in elaborate detail during recent weeks (AW Nos. 7, p. 21; Nos. 14, p. 18; Nos. 18, p. 38 and p. 39 of the current issue) in name and more of the technical frontiers for an extremely imaginative and broad scope Air Force space system program with through its initial security screen.

The USAF proposals offer a far broader utilization of space to radically improve our national defense posture than anything that has been advocated in space tech-

nology by NASA or any other organization concerned with the area. Whether this USAF program is technically sound and militarily valid issues questions that will certainly have to be answered in the major debate on this subject that is certain to materialize, both in public and behind the security screen, when Congress returns to Washington next month and a new president is inaugurated.

But from the basic state-of-the-art requirements is virtually every area of the space technology spectrum that we now appearing in early experimental form, it is evident that technically, we are still in the early stage age of this historic era. The technical ingenuity now in prospect offers an enormous opportunity to move forward faster and on a broader front than even the most enthusiastic "space cadets" ventured a few years ago.

#### A New Look Needed

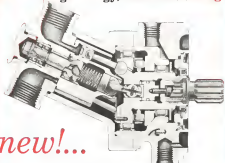
In addition to the major re-evaluation of projects as well as space technology, to strengthen our national defense posture, these are technical developments in prospect make a major reappraisal of our entire national space program necessary. This reappraisal should include management organization and techniques, possible acceleration of pace, expansion of goals and institution of a sense of vital national purpose in this program, which is still lacking above the technical working level of government and industry.

In making this reappraisal, there should be no timidity about raising such issue of the program management techniques and organizational structure that were formerly conceived in the paralytic cold-war spirit. This reappraisal also should be accelerated against the virulent attacks of budgetists that have badly crippled the space program in its formative years. The budgetists' problems of an adequate space program are genuinely formidable, but they should be approached with the viewpoint that this is high risk capital being staked on the major scientific frontier in technology that can give industrial dividends materially, economically and politically in the future of this nation. There must also be an adequate preemption against the over-eagerness of technical conservatism that are no longer justified in view of the rapidly changing needs of the past year and the new goals already appearing on the technical horizon.

This major reappraisal of the national space program, which is approaching as inevitable in the form of the cost, must be allowed to degenerate into the petty bickering of another inter-service or inter-departmental rivalry for the major share of a budget pie. It must be confrontation with the firm resolve that this is one of the most significant efforts in our national history and with the understanding that its results will determine in large measure our stature as a nation in the history that unfolds during the last half of this century.

—Robert Hertz

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## WHO'S WHERE

### In the Front Office

Dr. Gordon S. Bowers, Dean of Aeronautics Institute of Technology School of Engineering, elected a director of Bell Aircraft, Inc., Cranford, N.J.

Donald W. Douglas, head chairman, Transcontinental Corp., Long Beach, Calif., was AW No. 7, p. 33. Other directors are A.C. Lee, Dr. George Van Dyke, H. North, John A. Douglas, Charles E. Allen and Robert F. Whitcomb.

Ernest E. Wood, president, Sprague Electric Co., North Attleboro, Mass., according to late John E. Sprague. This company has appointed the following vice-presidents: William J. Salsburg, chief engineer; Neil W. Wick, engineering and sales; Walter E. Long, technical director; Robert C. Sprague, R&D technical advisor. Appointed vice-presidents: David B. Peck, general products; Charles R. Wright, chief; Gerald G. Kilgus, industrial and aviation; John E. Bower & Carlson, corporate planning and relations.

Reginald C. Hart, president, International Research and Development Corp., Wash., D.C.

Gold Fubell, vice-president operations planning, Douglas Aircraft Corp., Wood Ridge, N.J.

Kurt W. McMillan, executive vice president, The Boeing Co., New Britain, Conn. Mrs. Roscoe N. Griffin, executive secretary, Edwin A. Ingelstrom, assistant treasurer.

Al George LeClerc, vice president, parent Lockheed, Ltd., Division of General Electric Co., Burlington, N.Y.

Conrad, Ltd., Montreal, Canada, has announced the following appointments: Frederick R. Koenig, executive vice president sales and finance; John D. Davis, vice president and secretary; John E. Blanton, controller; Theodore C. Parker, treasurer.

Dr. Charles F. Robinson, a vice president of Consolidated Lockheed Corp., is chairman of Bell & Howell, Pasadena, Calif. Dr. Robinson continues as director of the Bell & Howell Research Center. William E. Vickerman and Clyde M. Kelly, vice presidents, Letter Industries, Beverly Hills, Calif. Mr. McKenna, co-owner in business and controller and Mr. Kelly, in charge of advertising, public relations and corporate communications.

Charles E. Shuman, technical vice president, market development, Raytheon Co., Waltham, Mass.

Mr. Geo. Robert H. Booth, USA, Chief of the Defense Systems Support Agency, Washington, D.C., succeeding Vice Mr. Edward N. Parker, USA.

### Honors and Elections

Dr. E. E. Jensen, president chief engineer and head of the Project Dynamite of Bristol Siddeley Engines Ltd., has been awarded the Swedish Order of Merit. Lockheed's Charles B. Bower, in recognition of the work of the Bristol Siddeley group design team and of the company's achievement in the field of supersonic propulsion. (Continued on page 117)

## INDUSTRY OBSERVER

▲ Air Force will use Lockheed C-130 for air transport of the Soviet reconnaissance satellite, in early package, which is too big for Lockheed C-119, is likely. The Soviet plane is scheduled before the first news, attempt was planned for the Soviet System for the 1959-60. The Soviet plane, to get to first C-130 about Jan. 1, and conversion from new C-119 until for December 1959 to a first of five C-130s is to be completed next spring.

▲ NASA's Echo II passive communication satellite, probably will be 140 ft. in diameter, in contrast with the size of the 130 ft. Echo I sphere. Echo II will be sphere is expected to use sun-back contraction to give it increased light.

▲ Corbin T-105 interceptors will be used in a chain plan for the Vietnam, Southeast Asia. F-105 will monitor the beach and inland points. Vietnam and Spain. Mission will require control of the Lockheed U-1 for the close work. (AW News 31, p. 27)

▲ Ultraviolet infrared guidance system with all-weather capability for ballistic missiles has been proposed to the Air Force by Avco Research and Advanced Development Division. Ultraviolet system, operating at the opposite end of the light spectrum than infrared system, have a number of possible applications, including missile navigation system.

▲ Proposals are due today for a spectrum surveillance system capable of monitoring all frequencies radiated at Air Force, Nevada Test Station's launch site at 10,000 ft. in the air. The system is to monitor frequencies and their nature and origin as an effort to track down and identify sources of electronic magnetic interference with operations of missile systems going down check out and launch.

▲ Australian technical work from the General Motors, Ill. for the B-57 fighter role of modifications are made to give the French fighter a 1,500-horsepower. With the technical evaluation complete, final decision between the Mirage III and the Lockheed F-104, including financial considerations, now can be made.

▲ Recent Navy breaking on purpose and failure of the Transit satellite system held by Bureau of Ships Bureau of Weapons and John Hopkins Applied Physics Laboratory (AW Oct. 17, p. 21) was attended by about 50 companies. It was not a formal closed briefing, but requests for proposals for proposed digital equipment to process navigation data from Transit system probably will be issued within 60 days, possibly with a formal closed briefing. Navy indicated it does not want to repeat system computer development for this use.

▲ First aircraft-made compatible flight test of the Air Force-Douglas Skybolt nuclear-tipped ballistic missile, originally scheduled for this month, now has slipped to mid-June. A B-52 will carry four dummy Skybolts on test flights from Boeing's Wichita plant.

▲ Philippine Air Force is considering the Lockheed F-104 and Convair F-102 as replacement for its North American F-86F. F-102 is favored because of its all-weather intercept capabilities. Availability of Mutual Defense Assistance. Both funds will be a major factor in any equipment change.

▲ British Blue Steel air-to-air missiles are being shipped to Australia for test flights over the Western wing from Royal Air Force Woomera. Missiles are supplied by Royal Australian Air Force in C-119s.

▲ Switch to a normal flow nozzle could cut the present 18 ft. length of the 1.5 million lb thrust Rocketdyne F-1 engine to about 20 ft. Vehicle length has replaced diameter as the major size problem with such rockets as before and the proposed Nova which would be provided by the F-1. Rocketdyne engineers are the basic consideration. Some other members of the system flow nozzle is its pressure sales appeal, although efficiency is slightly below that of the larger bell-nosed nozzle.

## IMAGINATION ON THE PROWL

System leadership combines imagination, practical know-how, and firm management. That aggressive combination is the Bendix Systems Division. Career opportunities include the Eagle missile system, Advent satellite communications, space projects, and airborne infrared systems.

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## Washington Roundup

### Military Space Ferment

An expanded military space program is almost certain to result from the combination of legislative and executive department changes expected during the early days of the Kennedy Administration—but not until after the dust has settled around some bitter skirmishes on Capitol Hill.

Reorganization of the Defense Department, which includes the outside possibility that all military research and development will be put under one agency, may have to be argued out first.

As Fawcett has the most ambitious plans for growth (see p. 26), and has had its grandiose crash. It has support for at least some of its ideas from Vice President-elect Lyndon Johnson, who will be a powerful factor in the Administration's space decisions.

Both the Senate and House space committees have shown sympathy in the past for the senior defense-making the responsibility for space defense system but being dependent on the National Aeronautics and Space Administration for much of the supporting technology.

The House committee has asked each service for detailed compilations of all current and projected space programs. They are due this week.

Budgets of the military services for Fiscal 1962 will total only about 2.5% above the current year by the time Secretary of Defense Thomas Gates submits them to the Budget Bureau next week. Cuts for most of the existing and new programs appear quite important. York D. Hatcher, York, director of defense research and engineering, is an respected lobbyist. York got into opposition on a number of cuts from John Babel, the man who filled his post while York was ill recently.

### Space Council Revival

After almost a year of inactivity, the National Aeronautics and Space Council may be reactivated. It was created in the original space act, partly at the insistence of Lyndon Johnson, quickly to place responsibility for the space program immediately at the presidential level.

President Eisenhower asked for Johnson that the Council be abolished. Permanent staff was never organized, and even when the Council held meetings last year it did not function in Congress intended.

Kennedy wants close contact with departments than Eisenhower had. The Council which brings together the Secretaries of State and Defense, the heads of NASA and the Atomic Energy Commission and others is an ideal vehicle. Johnson himself probably would not sit in on meetings.

A Dec. 15 deadline for presentation of industry's views on reorganization has been set by the House Ways and Means Committee. Reorganization is in various stages, the question that is presentation is a bill to place the space program in the Reorganization Act in its present form. Aerospace Industries Assn. plans to support a bill, force to negotiate an industry role position.

Key amendments agreed by AIA last year were rejected, and Congress extended the act until June 30, 1962. The extension has required Ways and Means to make a study and submit recommendations by next May 31.

### Senate Studies CAB

Senate Commerce Committee's staff study on the Civil Aeronautics Board and other regulatory agencies under the new act, but before part of the program is reduction of the constantly increasing backlog of cases.

General Accounting Office is making a thorough study of Interstate Commerce Commission, at the request of Chairman Warren Magnuson (D-Wash.) with the intent that findings will be applicable to other quasi-judicial agencies.

GAO's report is expected early in January, and committee hearings are expected to be held early in the next Congress.

As Fawcett is making a concerted effort to show that its Minuteman missile system is 20% cheaper than the Navy's Polaris. Navy claims its one figure includes everything down to the temperature for the crew to and from the submarine. It says the Air Force rules its own accounting rules ignoring life costs.

14. Gen. Robert J. Wood has labeled the Nike Zeus anti-missile missile a "terra-space weapon." Wood, head of the Army Air Defense Command, says this weapon is too strict on the ground even though it kills targets that are way out.

Westinghouse will develop a high energy arc heater for NASA under an assumed \$100,000 contract that will cost NASA nothing unless the heater develops an output equal to or greater than specified performance.

—Washington Staff

# Air Force Outlines Broad Space Plans

USAF prepares to fight for space policy changes to pave the way for a variety of weapon systems.

By Larry Hoads

Washington—Air Force is preparing a major political offensive to bring about changes in national space policy and law that would let it proceed with detailed, specific plans for space weapon systems involving "hens of their own, perhaps hundreds of thousands" of satellites in orbit in the next 15 years.

In the latest of a continuing series of national hearings to identify leaders and groups within the service, Air Research and Development Command's Ballistic Missile Division has claimed that Air Force has offensive, defensive and logistic missions to perform in space. "Military space," defined as space out to 10 earth diameters, is the battleground of the future, USAF says.

Air Force has its position on the results of a number of funded and unfunded studies, completed by itself and others, in the past three years, in briefing Defense Department policymakers and in preliminary defense of its arguments for the next session of Congress.

Congressmen in key committee posts and their staffs already have received informal briefings. They have been told that Air Force's plans for future satellite utilization of space are far more aggressive and complete than those of the Office of the Secretary of Defense and the National Aeronautics and Space Administration.

Air Force is bringing its claim to a broader space role on the language of the National Aeronautics and Space Act of 1958. That act charges the civilian space agency with making "adequate provision" for astronomical and space activities.

It is also now to accept that astronomical activity is primarily associated with the development of space systems, satellite operations is the defense of the U. S. (including the research and development necessary to realize effective protection of the defense of the U. S.) shall be the responsibility of, and that be directed by, the Department of Defense.

The argument advanced by Air Force is that it cannot fulfill its portion of the space defense mission without closer cooperation at the top official levels of its need to pursue a broader research and development program on space systems.

Until now, policy based on the space act has given NASA the responsibility for manned space flight and development of large boosters. Air Force wants to use this policy changed to allow it to perform both tasks at necessary to carry out its own mission, regardless of what the civilian agency does.

Policy possible. Broader claims it will be reflective after 1964 (see p. 25).

Systems already in development or proposed by USAF for its expanded space program include:

- **Chickadee**—Satellite Ground Reassignment System (GCRS), sometimes called Reassignable Intercontinental Ballistic Missile, and multi-mission ICBM, sometimes called Rocket-Vision.
- **Redoubt**—Spad, Radar, Storage and Insurex.
- **Laguna**—Satellite Maintenance and Repair Techniques (SMRT) and Military Space Launching System (Phosor).

- **Space Plane** (AW Oct. 31, p. 24).
- **Reconnaissance**—Satellite photographic satellite, Maine infrared ICBM launching detector satellite, and Space satellite orbital intercept (see p. 27).

- **Communication**—Communications Satellite, Advanced Research (CSC), which until recently was called Freed Link Aerospace to General (Flag).

In showing general areas broken have emphasized that the U. S. must possess more ICBMs, Kents and must continuously strive for expansion in its arsenal of strategic weapons.

It is desirable to reduce launching costs broken and so that system involving tens of thousands of satellites will be economically feasible.

Additional objectives are to increase satellite life, improve component reliability and better space power supplies.

Maneuverability is slight will be a standard requirement for all new ballistic missiles and satellites.

Positive Control Bombardment System or Reassignable ICBM, would involve three in a multi-mission satellite orbiting at 200 miles, an ICBM.

First shot in orbit, positive interception of the missile would be used to prevent attacking a target from distances of a little more than 5,000 miles to as much as 10,000 miles in.

This would be accomplished by using the trajectory angle from orbit.

There would be an 18-hour five-day flight period during each pass of the missile when it could accept a command. On command, the satellite would reorient to intercept its target or to the command to return to its programmed route, separate the on-orbit-on-receive vehicle from the satellite and the re-entry vehicle would proceed to the

## RCA Will Develop Saint Payload

Washington—Radio Corporation of America has been chosen to develop the first stage and separation payload for the Saint satellite and its separation and reentry.

Payload will weigh nearly two tons and will carry a housing range and advanced communications for the Saint satellite for observation purposes (AW Nov. 14, p. 26).

Saint will be launched from Cape Canaveral by an Atlas booster. It will be injected into orbit by an Agena II second stage.

Initial contact with the mission satellite will be from about 100 miles and about 100 miles. The satellite will be released to orbit about 100 miles above the ground.

Developmental studies are scheduled to begin in December 1961. The launch, which will consist of the role of one or more three months and will begin in 1963 will be directed against satellites in 25 billion pounds launched into orbit.

RCA contract will total \$25 million of about \$10 million budgeted for the first stage development effort. Work will include the development of the Saint and the Saint's payload.

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Expanding its interest into the field of big boosters, Air Force has established Project Phoenix, or Military Space Launching System, which would use a 100,000-lb. thrust and would be capable of putting manned satellites into orbit.

Phoenix is a sort of overall approach to selection of space launchers that would incorporate and combine boosters and launching from mid-launches at a system development is planned to begin in 1961 with the first launch planned for 1967.

## Weather Ship

Apex. Plans would be a type of weather ship. This 500,000-lb. vehicle would take off from launchers with a small load of liquid hydrogen and then fly in the center of the atmosphere. While flying there, it would gather data through a variety of sensors, cameras and liquid and firelessly transfer it to ground stations. After the cycle the vehicle would again rise into space and be launched on its launch in explosives mission.

A variation of this concept has the vehicle operating in a space environment to direct military operations in actual use or in extended use in deep space.

In the area of defense against ICBMs, called MCM, Air Force Air Force also is interested that satellites directly after their launch from a launching and or site. This would be done by satellite.

There are several ways to accomplish the interception and kill. One is to have a center satellite, which would be able to intercept the kill. Another is to have a center satellite, which would make the interception and kill in its own orbit.

In any case the missile must be destroyed somewhere after it rises above its own orbit. This would be done by a center satellite, which would be able to intercept the kill. Another is to have a center satellite, which would make the interception and kill in its own orbit.

## Random Orbits

One approach is that studied in 1958 was called SAINT (AW Oct. 31, p. 11). This concept calls for 1,000 to 2,000 satellites in random orbits at about 200 miles above Earth. Each satellite would carry from one to ten missiles which would be launched for interception and kill. Detection capabilities would be built into the satellites.

Another study, conducted by Thompson Radio Works and called RAS, also calls for 1,000 to 2,000 satellites in random orbits. In this system the satellites would be able to kill the kill. This study is designed as a single one with no moving parts. Each





**REDSTONE-MERCURY** ignites three engines and then reaches orbit. On shutdown signal, which came with indication of

ground track, boost clamp was released by explosive bolts and escape rocket fired, carrying the escape chute, tanks with it.

## Second MR-1 Test Planned in Two Weeks

By Edward H. Kohnen

Washington — Mercury Redstone 1 (MR-1) launch attempt will be expected in about two weeks with electrical ground connections altered to eliminate the abnormal ground connection wiring which shut down the booster engines just after ignition in the initial MR-1 attempt.

Recent MR-1 test (FW No. 28, p. 28) was the final extensive launch failure in the Mercury program. Previously, the Atlas-based MAV-1 and a Lath, Inc. flight failed.

Although National Aeronautics and Space Administration has yet to fit a rocket booster propulsion capsule Mercury program managers stress have met in the launch problems, at the capsule during the short Redstone test. The so-called capsule following track signal it received. It will be fitted with new, cheap, timer and parallel motion meters, which are mounted during the Redstone test and it will be flown as MR-1 in the same manner planned for the launch that failed.

Meanwhile, Director Robert R. Gilchrist estimates that the Nov. 21 failure will delay the program a matter of weeks, and it will have no significant effect on program cost since both the capsule and booster reached successfully will be flown. Gilchrist said that a normal Redstone-Mercury flight will be made early

next year, and the mission, Atlas-based orbital mission will be launched before the end of 1961.

The MR-1 booster will be, once again, the Redstone used in the initial attempt failed 0.25 to 0.3 in. before dropping back on the pad, and it was dropped back to Marshall Space Flight Center for a diagnostic check.

### Early Disconnect

Dr. Jacobus P. Kortebein, Mercury program chief at Marshall, traced the launch difficulties to early disconnect of the power plug used to connect ground connections to the booster Power and control plugs, programmed by disconnector, unsatisfactorily, usually pulled loose, with a time differential of 20 milliseconds. Power plug is used to ground the boosters and separate side of the boosters, and with the booster not grounded, the control circuit just will a voltage indicator which checks the boosters and shut down the capsule Power plug that was found to be 1 in. shorter than the control plug and this could have resulted in a slight misalignment.

Kortebein said the situation is being corrected by lengthening cables in an area that the booster will remain grounded until the control plug is disconnected and the boosters both plug the case are.

Supposed, indication has not so-

ceeded to more than 50 launches of tested and research vehicles based on the Redstone booster. Kortebein said possible explanation for the MR-1 incident is that wiring for the MR program is much more complex, and the small switch pulled up a voltage which would have been avoided in standard Redstone switches.

Some of the damage caused by the Mercury group from the failure was contained within its zone, was isolated quickly and found two to five. Capabilities performance this was encouraging.

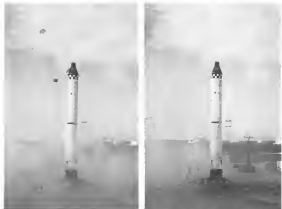
### Capsule Sequence

Capsule and the separate tool, place where the capsule could signal was given.

• Tower clamp was released by explosive bolts.

• Escape rocket fired and separated, and separated the capsule and covered the 35 ft. rocket plus 1,500 ft. west of the pad, where it burst into the void. Rocket burst into several and lifted the tower system to an altitude of more than 10,000 ft.

• Recovery system was used by getting capsule power arms upon return. In a normal mission, the event is fixed at 42,000 ft. altitude. During the capsule, was at 40,000 ft. previous, the homometric system was closed and the escape parachute was fired in the center. The drops, chute was lifted



**BOGART CHUTE** pulled base into chute from ground in right photo and then the escape mission, chute. Escape rocket and just chute system will be replaced in this capsule and it will be used again for a second attempt to launch the first Redstone-Mercury flight.



Most ob-



**FIRST PHOTO** of the Bell P-1127 VTOL strike fighter package shows two of the four revolving nozzles used to vector the thrust of the plane's single Bristol Siddeley BS51 forward fan turbojet. Forward nozzles discharge portion of fan flow; aft nozzles handle engine flow. Inlets have been modified with bellmouth lips for best flow characteristics.

seven agree this is a desirable approach to produce maximum return on the Hawker studies and the investment in the program.

The Hawker design as it stands now could not meet an updated requirement, because it represents the state of the art in VTOL of about three years ago.

Hawker has not commented on any of the specific detail design features, but some of them can be determined from study of the photographs.

#### Design Departures

Landing of the P-1127 is a departure from the family resemblance of the last few fighters designed by Hawker engineering teams under the direction of Sir Sidney Cotton. The high wing has large negative dihedral and a smooth, straight leading edge seen in planform. Sweep angle on the outer of 35 deg., and the planform taper rate is about three.

Wingspan is 24 ft 4 in. Conventional aircraft are fitted for lateral control during nonhovering flight; it appears that leading-edge flaps are also fitted for flight operations where more conventional takeoffs and landings are desirable or necessary because of aircraft overload.

Landing gear is a tandem installation, with main gear ahead of the engine's center of gravity and a single nose wheel forward. Brakes on the landing gear rotate the fuselage, which leaves the wing structure completely free of control and reduces its structural weight to a minimum. Outboard gear is fitted to the wingspan and reaches directly off into a landing.

Length is 41 ft 2 in. long overall. Vertical and horizontal tail surfaces are minimum not increased tail is the side type.

Third control fin area is added below the fuselage for additional static directional stability.

#### Reaction Control System

Most difficult feature to analyze from photos is the reaction control system of the plane. There are obvious control nozzles under the nose, and at the intersection of the vertical and horizontal tails. If general design practice is followed, the power reaction-control system of the Short SC-1 (AW Oct 13, p. 71) these fan-surface nozzles are used for control in the pitch plane. Other openings shaped like reaction control nozzles are visible on the sides of the fuselage for the forward engine exhaust nozzles, and on the wingtip leading edge fairings. Taken of three—if they are needed—could be used for roll control.

Yes, control nozzles are not apparent and can not exist as part of the reaction system. There is a pair of fairings on the undersides of the wing, about midspan of each panel, which might conceivably lead to reaction nozzles for roll control. An alternate source would be to vector the nose and tail pitch nozzles so that lateral components of the reaction control thrust would produce a rolling moment.

Bristol Siddeley BS-51 powerplant is a four-fan engine which discharges both fan and engine exhaust through four rotating nozzles, two forward for the fan and two aft for the engine. These nozzles have several guide vanes

to turn the flow through nearly 90 deg. to the plane of the nozzle exit. The nozzles can be swiveled so that all the engine and fan thrust is directed at an angle from a ten degrees forward of the vertical to straight aft.

Plan of the engine is the lightweight Olympus powerplant, the fan stage was adapted from the four three compressor stages of Bristol Siddeley's Olympus turbojet. Engine designers added an extra low-pressure turbine to the base Olympus frame in order to drive the fan stage.

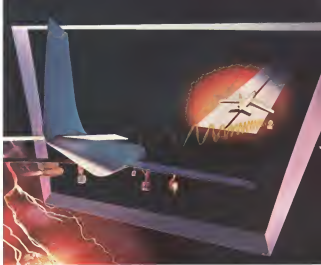
Discharge from the fan is split to go partially through the engine and partially around it and out through the forward jet nozzles.

#### Engine Thrust

Estimated overall thrust of the engine is 15,000 lb, but the best estimate is that the engine is running well below its design figure, perhaps at 12,000 to 13,000 lb.

The large rotating mass of jet engines produces gyroscopic coupling forces when an airplane is displaced around the yaw or pitch axis, and these forces are of significant magnitude to pose a serious problem to the designer of the control system in a VTOL vehicle. But in the BS-51 gyroscopic moment of the engine has been reduced to a minimum by driving the fan and the compressor in opposite directions.

The engine has been running on the test stand for the past year, the contribution to the Hawker aircraft is its first appearance in a flying vehicle. Development of the engine has been financed by the Materiel Weapons Development Program.



Bell's All-weather Automatic Landing System—simplified

## CLEARED TO LAND, WEATHER OR NOT

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The system has been flight-proved in more than 4,000 landings with all types of aircraft—small piston planes as well as airliners from the DC-3 and DC-7 to the large Boeing 707 jet. It now is being evaluated at FAA's Na-

tional Aviation Experimental Center, Atlantic City, N. J. Unlike other automatic landing systems, the Bell ALS is ground-based so a ground controller monitors every approach and landing. It can operate either fully automatically or under pilot control.

Military versions of the ALS have been ordered by the Air Force. The Navy has selected it for installation aboard the nuclear-powered aircraft carrier USS Enterprise as well as for its other large carriers.

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# CAB Explains Its Rate-Making Techniques

Board outlines approaches to help weaker trunklines; they include subsidy, higher fares, route changes.

By L. L. Dwyer

**Washington**—The reading room just opened that establishes new precedents for handling carrying of weak domestic trunklines has been proclaimed by the Civil Aeronautics Board in its final decision in the General Passenger Fare Investigation.

For the first time since all domestic trunklines became subsidy-free, the Board finally suggested it will again permit its subsidy for less profitable trunklines as part of its new program—where the interests of consumers, postal service and the national defense are served. It also stated that reimbursement of competitive costs may be a solution to the poor earnings character of some routes.

Repeatedly, throughout the 77-page document, the Board referred to the unstable condition of the industry resulting from "financial and other problems" created by the transition to full competition. It said it could not easily help independent trunklines until the industry has reached a more stable period.

## Difficult Problems

In its findings, the Board admitted that "the problem of accommodating the requirements of the weak and strong carriers . . . is one of the most difficult to be found in regulation." It added that postal time increases are not necessarily "the primary" but will solve the problem, and it then evolved its new policy by suggesting three final tools for dealing with less profitable carriers.

Overall examination of the general passenger fare structure might result in bringing the costs and revenues of individual carriers into closer alignment. As high-level rates of production firms with the view of increasing the cost structure was embodied from the times considered in the Civil Passenger Fare Investigation, but such survey now appears incomplete.

Carriers whose needs are not met in low level adjustments can seek higher fares. The Board admitted, however, that competition would probably prevent airlines from charging fares higher than the established level except in monopoly routes.

Reimbursement of routes to produce a more balanced competitive state structure.

Subsidy payments where the Board finds that such compensation is required in the interests of consumer postal service and national defense.

G. Joseph Morley told a concerning

eight carriers would cost \$112,500.

The Board decided that it could provide a guarantee that the industry should prosper at a weighted average of 10.5% rate of return since the standard is based on long-term security and the Board wants to discourage determination whether the industry's current fiscal conditions are temporary or long range. Profits in 1959 for the 17 trunklines were 7%, but they had dropped to 4.2% by June, 1960. The Board admitted that the industry's high level profits for the first three quarters are fully adjusted.

## Marketing Inhibitions

Changes we bring that must occur will be subject to ratification by a firm to ensure at this time despite a leveling off of market growth patterns. Most carriers are now in the grip of a tight competitive race for traffic and are not likely to run the risk of the very serious likelihood of oversteering, even as high density traffic routes.

Some observers are interpreting the Board's decision to imply that it will continue to permit fare increases and that the competitive forces will operate to the rate differences sufficiently to allow, from a social and national economic level. In industry has traditionally held that it should be granted the prerogative to determine a fare level within a range of about 10% below the rate level, and as a result the transportation may be self-sufficient rather than a burden on the state.

In the decision, the Board goes on to state that it is not to allow the trunk carriers any such freedom in setting a rate level other than to use that " . . . carriers whose needs are not met by general fare level adjustments, or whose routes are in first step toward cutting and increasing, and bring the rate of return to 10.5% weighted average rate. Under the Board's plan, the Big Four trunklines would be allowed to earn 10.25%, the smaller

quintile commercial and efficient service is, its terms of reasonable cost and the need of such carriers for revenue sufficient to enable such an carrier, under financial, commercial and efficient management, to provide adequate and efficient air carrier service.

In his dissent G. Joseph Morley, who recently has been frequently mentioned as a leading candidate for the Board chairman, expressed his concern that increased fares will depress traffic but emphasized that no bus observing appears to agree on the exact fare level where this will occur. On this point, Morley said:

"It is the present cost level's power to be permanent rather than temporary bulges, the carriers' high fare levels must be maintained whenever the effect may be on the movement of traffic and on substitution of the industry's current and anticipated high amount of capacity. If this, however, power to raise fares only temporarily inflated, and assuming that current fare levels are not likely to be raised, we will be able to take steps to reduce the industry's cost component into competitive cost levels and with increased traffic growth in the degree necessary, to profitable equipment utilization."

Morley said he would grant an 8.75% rate of return for the Big Four and 9.25% for intermediate carriers as "reasonable and ample."

Here as the main point brought in by the Board's final decision on costs and rates of return.

Standards for passenger fare regulation should be based on the profit element rate, depreciation and taxes. However, the Board declined to use its rule level below the rate level, and as a result the industry was found to be sufficiently flexible for such purposes.

Industry profit element should be regulated by the conventional rate of return, but the Board's decision to use the rate level below the rate level, and as a result the industry was found to be sufficiently flexible for such purposes.

Rate of return of 10.25% to be allowed the Big Four carriers is derived from the averaging of 4.5% rate of debt and 16% rate of equity to a capital structure consisting of 30% debt and 70% equity. The Board's final decision on the rate level is based on the averaging of 7.5% rate of debt and 15.5% rate of equity to a capital structure consisting of 55% debt and 45% equity.

Rate level to be used for the five quintiles should consist of net working capital, net operating projects and equipment after depreciation for depreciation and amortization, and other costs and capital costs including equity.

Depreciation charges on flight equipment should be based on a seven-year life and 15% residual value for passenger aircraft and equipment. Depreciation charges for other passenger aircraft should be based on a 10-year life and 15% residual value for aircraft and a five-year life and 15% residual value for other aircraft. The Board said 5% of aircraft costs should be included in the residual value as a condition of amortization.

On this point the Board quoted the Bureau of Census's statement that a flat depreciation charge of 2.45 cents per available ton mile is based on the overall industry experience for the 12-year period 1948-1959.

It also supported the position that the most serious that the Board was required to accept in its decision was the industry's view that the industry is not to be allowed to accept a depreciation charge of 2.45 cents per available ton mile is based on the overall industry experience for the 12-year period 1948-1959.

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## Imminent Certification Seen For BEA Vanguards; TCA's Delayed

London-Vienna in existing full passenger-carrying certification for BEA Vanguard type 931 from the Air Transport Board now. It expects to be able to offer the flights at least with an aircraft of 400-450 seats.

Certification for the Vanguard type 931 for TCA is not expected until later in December due to ongoing problems with the Civil Aeronautics Board.

BEA has already planned to use the Vanguard on an ad hoc basis in the London-Paris run over the Christmas period. But fully scheduled operations are not due until March 1, when the aircraft will be used on British national air routes, such as London to Zurich and the Zurich to Rome.

Vanguard G-AMFV fitted with the fully modified passenger type engine received its final certification from the Civil Aeronautics Board on Oct. 31. Flying a simulated solar pattern in a 1000 ft climb over four legs per day, the aircraft completed the 200 ft in 25 seconds. The aircraft is now being used in the program for the final certification by the Civil Aeronautics Board.

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FIRST CONVAIR Model 990 jet transport is rolled out of the plant at Lindbergh Field, San Diego, Calif. Ground Electric C1931-21 will tow

engine pods at 6 ft. in diameter.

## Convair Rolls Out First Model 990 Jet;

## Testing Begins

By Russell Hawkes

San Diego, Calif.—The Convair 990 jet transport, formerly designated the Convair 680, has been rolled out and is scheduled to make its first flight in January.

Ground testing of the number one aircraft already has begun in a Convair test hangar at Lindbergh Field here. Three other airplanes will join it in the Federal Aviation Agency's aerodynamic turbulence test program and another will be used for vibration stress testing.

The 990 is to be in service with airlines in 1964. It will be built in two versions: the basic 990 for domestic service and the Convair 990 for intercontinental routes. Convair has announced a total of 17 firm orders for the two versions. American Airlines has ordered 25 of the domestic version and Comair has been ordered by Western (7), Scandinavian Airlines System (21) and Real Airlines National of Brazil (5). Trans World Airlines is expected to get six in addition to those ordered (AVN, Nov. 25, p. 78).

The 990 has a maximum cruising speed of 840 mph, which is 25 mph faster than the earlier Model 580. Convair intends to have it certificated for 840 mph cruise speed. Most of the speed improvement is due to the installation of General Electric C1957-1 turbofan engines, each rated at 16,100 lb. thrust, and to a radically new high speed wing design.

The most obvious innovation in the new wing design is addition of four



CAPOLEDs are distributed to ward turbulence with lower wing surface area. Flattening the bottom also makes possible a longer flap span.



GENERAL ELECTRIC designed the thrust reversers, which are fitted into the pod when retracted. Double-chilled Fowler flaps extend beneath the capole.



MODEL 990 can carry up to 121 passengers in typical configuration. Cabin is supercharged with air made cool below the wing root leading edge.



CONVAIR 990 wing has a leading edge sweep of 34 deg. and wing includes four speed spoilers to reduce drag.



CONVAIR 990 TRANSPORT at 139 ft 5 in. long and 39 ft 6 in. high. Wingspan is 129 ft. Note chevron thrust nozzles.

streamlined airfoils on the upper surface of the wing extending aft of the trailing edge. The airfoils are first demonstrated experimentally by scientists of the National Aeronautics and Space Administration, are called speed capsules by Convair engineers (AW Sept. 3, 1959 p. 50). The capsule tails, each riding aft of the wing trailing edge, have fair lower surfaces to maintain their influence on airflow along the lower surface of the wing. This arrangement also allows trailing edge control surfaces to extend beneath the capsules. The raised capsules are 23 1/2 ft. long

and the outboard capsules are 24 ft. long. Maximum thickness of the large capsules is about 2 ft.

Sample of the 990 wing is 38 ft. at the leading edge. Convair officials call it the throat wing being used as a jet booster. Leading edge slots which are extended at the same time as the trailing edge flap postpone airflow separation to higher angles of attack, enabling pilots to ride off and land in near high capsules that shorten takeoff and landing distance requirements.

Wingtip trailing edges are slotted to reduce drag. Tailored flap sec-

tions are double-slotted, full Fowler motion type. Outboard sections are also double-slotted with full Fowler motion.

Convair claims the 990 can land and take off from most airports used by four-engine propeller-driven transports, which would make jet service available to many cities that lack airports large enough to handle the jet now being used in air traffic.

Convair officials repeat that the modular replacement philosophy of various sections has been adopted in the 990 to keep down the time and cost of maintenance. Access doors make up 17% of the fuselage surface and almost 55% of its lower wing surface to speed removal of faults, parts and the installation of improvements. Deck components are used in engine pod wing, plumbing and structural reinforcement.

The General Electric turbojet engines are reported to be 40% more efficient than the military J79 turbojet on which they are based. Diameter of the engine pod is nearly 6 ft. Steel chevron thrust nozzles form the external surface of the aft end of each engine pod, when the nozzles are in the cruise position. Moving between the engine exhaust and the low velocity ramjet of the jet with no reduction, engine nose, that additional speed improvements are not used.

The base 990 carries 15,110 gal. of fuel. The Convair 990 carries 15,075 gal. and has full provision for over-stowage. The speed capsules on the wings are used for fuel storage. The 990 can accommodate 96 first-class passengers in four-above seating or about one hundred in between in mixed seating arrangements. The cabin fittings are designed to let the cabin operator change the mix of first-class and coach seats in next day-to-day needs.

At 47,000 ft. the cabin of the 990 can be pressurized to the equivalent of 6,600 ft. At 30,000 ft. cabin pressure can be equivalent to sea level. Minimum cabin pressure differential is 5.7 psi.

## Convair 990 and Coronado Specifications

### Performance

Cruising speed	640 mph
Range (all fuel on board, normal reserves, at long range cruise at 5500 ft.)	4,360 mi.
Stalling speed (landing configuration)	191 mph
Maximum cruise altitude	40,000 ft.
Rate of climb (sea level, normal power, thrust weight)	3,210 ft./min.
Fuel consumption (30,000 ft., average cruise power)	4,410 gal./hr.
Takeoff: CAR runway for 2,000 ft. takeoff	5,710 ft.
Takeoff: CAR runway for 1,000 ft. takeoff	4,600 ft.
(sea level, standard conditions)	
Landing: CAR runway	4,770 ft.

### Capacity

Passengers at full class full coach	121
Perkins (first class coach)	93,170 lb.
Fuel (Convair 990)	15,110 gal.
Oil	20 gal.
Cargo	5,020 cu. ft.

### Dimensions

Wing span	129 ft.
Wing area	2,780 sq. ft.
Length	139 ft. 5 in.
Height over tail	39 ft. 6 in.

### Weights

Maximum landing weight	110,000 lb.
Maximum takeoff weight (Convair 990)	110,000 lb.
Maximum ramp weight (Convair 990)	110,000 lb.
Maximum zero fuel weight	110,000 lb.

### Engines

Four General Electric (J79-23) turbojet engines equipped with thrust reversers. Engine rated at 16,100 lb. each.	
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Control panel and indicator (above) from an Edo Loran 240 can be mounted in the cockpit in instrument panel, reducing 1/4 ATR in the cockpit and total weight only 25 pounds.

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| • Air Canada                | • El Al Israel Air Lines         | • KLM Royal Dutch Airlines   | • Scandinavian Airlines System      |
| • Air France                | • Flying Tiger Line              | • Caribbean Airlines         | • Transair and Western Airlines     |
| • BAC                       | • Canadian International Airways | • Northwest Orient Airlines  | • Transair                          |
| • Canadian Pacific Airlines | • Delta Air Lines of Israel      | • Pan American World Airways | • Transair American International-M |
| • Cathay Pacific            | • Israeli Air Lines              | • Garuda Airways             | • TWA—Trans World Airlines          |
|                             | • KLM Air Lines                  | • Also in use by MATS        |                                     |

and by growing number of corporate aircraft engaged in over-water operations.

Edo Loran complies with FAA TSO D18

For complete information on Edo Model 345A Loran, send for Descriptive Literature to Dept. C-4

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## Airline Bid Requests Canceled by MATS

Washington—Mats Air Transport Service has canceled requests for bids from commercial airlines for over-water transportation of military traffic in 1961 pending further study of its capacity requirements.

Cancellation of the bid requests came after airlines had submitted their bids. It is the result of the presidential order last month directing a cut in the number of dependents of military personnel abroad.

Commercial carriers have received firm contracts for military traffic for the last three months of 1961, but future contracts will be let in MATS on a month-to-month basis beginning Jan. 1 when the last of the monthly quota of 15,000 military dependents and civilian personnel return to the U. S.

Incidents in the past on the effect of the presidential order will have on future traffic potentials although it is generally expected that the large-scale north of some 254,000 persons will create a substantial imbalance of passenger traffic until July 15, 1962 when the present is to be completed.

During the third quarter of 1960 commercial carriers transported a total of 118,151 MATS passengers between the U. S. and overseas points in both directions at a contract cost of \$11.6 million. Total of 194,331 passengers were military personnel, 62,000 were civilians and 9,400 were dependents of both categories traveling on a space-available basis. Most of the traffic was transported in charter flights.

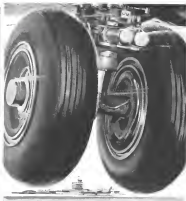
During the 12 months ending June 30, commercial carriers had a total of 462,256 military passengers under contracts that brought the carriers \$47.6 million.

## Brancker to Operate Consulting Agency

Montreal—W. S. Brancker leaves traffic director of International Air Transport Assn., will now Canadian Ltd., a new consulting and advice agency in aviation fields.

The company with headquarters here, will specialize in transit planning and traffic development and will provide advisory services to airlines.

Brancker's forced resignation from IATA earlier this year created a void right between the IATA executive committee, which requested Director General Sir William Hildon's request for his resignation, and a request of delegates to the association's general meeting in Cape Town, who wanted to see Brancker retained in the post (AWT Sept. 12, p. 40).



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## ALPA Forms New Attendants' Division

By David H. Hoffman

Moore Beach, Fla.—Director of the Air Line Pilots Assn. disclosed his firm does not want to do with flight attendants have decided to form a separate stewards and stewardesses division. He said ALPA will be a common position.

The union division established during the coming years is available to ALPA if possible. It will be headed by Clarence N. Sarno, acting president of the former Air Line Stewards and Stewardesses Assn. since Ronald Quinn walked out of the pilot Chicago headquarters last summer.

All other local-levels of the local unions representing individual airlines to the industry-wide executive committee—pilot and cabin attendant organizations will be kept distinct. Moreover, the separate ALPA board of directors retained power to serve this relationship with associated stewards and stewardesses in a simple support role.

Inclusion of the so-called coupe class, fourth-ranked in the union, is allowing the firm of many pilots to lift that business model. ALPA would plan for expansion to role in shaping association policy (ALP No. 28, p. 40).

In another controversial area that is difficult to do at the club level, ALPA voted against making the entire aircraft crew not a president director. Instead it changed the title of Kay McNamee, Sarno's full-time assistant from executive vice president to executive administrator. This ALPA position was considered with recent labor legislation requiring that a union's top officials, who is popular role.

### Cockpit Tape Recorder

On the recommendation of Sarno, the pilots also endorsed installation of voice recorders on airline transports as well as in aircraft investigation. Such records, according to an explanation just issued by ALPA's safety engineering department, could become operational within two years.

If data already being supplied by standard flight recorder was supplemented by a recording of all pertinent sounds, cockpit conversation or events during emergency, the precise cause of at least 10 potentially unexplained pilot accidents in the last three years could have been determined, ALPA reported.

In perfect pilots' process and protect the possible means of an information for positive action, the association favors incorporation of an "on-wing" mechanism in the second recording system.

To reduce the economic impact of prolonged strikes, an action involving more than one large airline, ALPA wants to build up a reserve, flexible fund of \$750,000. In the event of major work stoppages, this fund would be used to pay the first demands for strike benefits, then replenished from membership assessments.

Also the necessity of lowering bank costs—cost though this is available to ALPA if possible, interest rates—would be eliminated. Debate on the same issue is held common to the latter portion of a day with associates arguing that the single association format and the availability of commercial money made a "new deal" necessary.

During its session with Federal Aviation Agency, the committee noted that the rate and number of accidents charged against airline pilots have increased sharply since promulgation of the Federal Aviation Act in 1958. During the session, it was noted by the Civil Aeronautics Act of 1958 and 122 regulations were filed against ALPA members in 1959 and 1960 to date 123 violations have been filed.

### Pilot Protection

To increase pilot protection on only two proceedings, ALPA's standing committee on FAA enforcement procedures recommended a much closer liaison between industry and the legal division of the association.

A pilot involved in an potential situation, the committee suggested, should immediately seek ALPA counsel for "non-legal" law suit the situation, as well as, in law, the legal officials on such, it appears, the truth of the matter is that they do not control the action to be taken. The decision is made in Washington, meanwhile, by once and legal action from those backgrounds. Therefore, technical complexity with the law is governing.

Recommendations aimed at reducing the price of aviation insurance were also discussed. ALPA's safety engineering department said the decision by ALPA as a traffic control committee. Among them:

- **Radar should not be used as a primary means of controlling an aircraft, separation. Radar, given the complexity, should be placed on a two-way communication system even though most aircraft now are equipped with transponders.**
- **Pilots should not be required to maintain a two-way communication system in the event of a breakdown in the two-way communication system on the ground. No should an Traffic Control (ATIS) system, pilots be charged, in such cases, frequency call (unplanned) loadings instead of at specified times.**

• **Aviation weather radar should be deemed an acceptable method for determining a course through an instrument area of boundaries.**

Regarding general aviation, ALPA's AIC committee, led by Sarno, is in the effort to develop a one-stop service capable of moving 125 aircraft per hour through an airport. It then issued the "airline" model in view of the fact that no known airport design could cope with the volume of traffic.

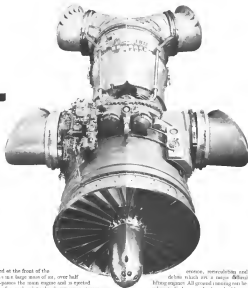
Without objection, the association's director authorized the pilots to begin using the services of the airline pilots in contracts with carriers participating in the Civil Reserve Air Fleet. Such provisions which would apply only of CRAT were activated, would be aimed at reducing Air Force expenditures on increasing the dependability of civilian flight crews in responding to an emergency.

A fifteen-man standing committee to study the situation and prepare a report to the association was also established by the Department of Defense as a review of the situation.

During the session, more than 100 prepared resolutions submitted by the members during the session. ALPA's 1960 annual board of directors also voted to:

- **Continue** during the association period shall remain, thus join the private ALPA membership for its part.
- **Oppose** any legislation that would transfer accident investigation work from the Civil Aeronautics Board to the FAA's, and other federal agencies which would not be in the position to handle the investigation of aviation accidents.
- **Maintain** the Chicago location of the ALPA office, rather than move the headquarters to Washington, D.C., as had been proposed by some members.
- **Attempt** to secure legislation establishing a three-year ban on strikes in the airline industry, and to set up a "emergency" fund to be used in the event of a strike.
- **Seek** further legislation aimed at shifting to the federal government the economic burden imposed on pilots who must work at age 60. This might come through a law, law or extended work until seventy hours.
- **Stop** up the payment of strike benefits to Southern Airline pilots. The new work of pilots, in the industry, is the strike, 12000 dollars would mean the amount received by Southern ALPA members in 500 per month with less, this might mean 5400 to 5710 per month depending on the pilot's former salary benefit.

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A fan, located at the front of the engine, drives a large mass of air, over half of which bypasses the main engine and is ejected in the form of a cool, relatively slow-moving stream through the two forward nozzles. The remainder passes through the gas generator and supplies thrust to the two rear nozzles. This arrangement greatly improves the frontal efficiency and gives the BS 53 a higher thrust/weight ratio, a lower specific fuel consumption and a lower noise level than any turbojet of comparable power in existence today.

**Conventional installation, operational simplicity.** The BS 53 is installed normally with forward facing intakes and the majority of its components are based on well-known principles already proved in service. These factors make for operational simplicity, easier maintenance, greater reliability.

**Reduction in ground crew and maintenance.** Because the velocity and temperature of its jet effluents are low, the BS 53 minimizes the problems of ground

crews, maintenance and protection of debris which are a major difficulty with conventional engines. All ground handling can be done with the exhaust discharging backwards like a conventional turbojet. Turning also is perfectly normal, and at take-off a short forward roll before the nozzles are deflected downwards ensures that all debris is left behind. As a result, the BS 53 does not require prepared sites and is independent of all fixed ground facilities.

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## AIRLINE OBSERVER

► Airline traffic volume may be developing an unanticipated but unexpected, rise during the last six weeks of 1988, following five months of depressed activity (AW Nov. 21, p. 33). Heavy holiday-season traffic coupled with relatively good weather conditions probably accounts for the slight upward trend.

► General Dynamics has now been officially redesignated the Convair 990 by General Dynamics Corp. (see p. 40). The change was made without fanfare in a press release on the 600 aircraft, and that is about all the manufacturer plans to do to make the redesignation official. Obviously, Howard Hughes paid the number 990 for the 501 of Convair's jet transports and needed that as logical number to be used for subsequent aircraft. Later, American Airlines ordered the more advanced 600 and decided to call it the 990. Service calls its intracompany 600 the Convair.

► Federal Aviation Agency is highly encouraged by initial tests on its ship board Vector installation, intended to evaluate feasibility of establishing a network of such navigation aids on weather ships across the Atlantic. Measurements on this initial shipboard installation indicate navigational errors of less than three degrees, comparable to those obtained with land based non-Vector. Airlines will begin to use the ship-board Vector soon on a trial basis.

► American Airlines will add extra coach seats on its Boeing 707 fleet to increase capacity during the peak holiday traffic period Dec. 10 to Jan. 7. The 707s will operate with 60 coach seats and 40 first-class seats, compared with current configuration of 68 coach, 36 first class. The 707s will have 68 coach seats, 36 first class, compared with the present arrangement of 60 coach and 45 first class. Temporary reconfiguration of seats is based on expected increase in demand for coach seats by passengers traveling for personal reasons and a seasonal decline in those traveling for business.

► Canadian CL-44 remains requirements for both takeoff and landing have been revised. 13,875 ft runway length for takeoff, 6,000 ft for landing, at 100,000 lb gross weight, is reduced from 7,660 ft to 6,880 ft. Landing field length at maximum gross landing weight of 165,000 lb is reduced from 4,700 ft to 3,980 ft.

► Federal Aviation Agency has been asked to make a simulation study of air traffic control activities on the Berlin terminal area by U.S., British and French forces in the German city. Full-scale study will be conducted with a dynamic air traffic control simulator at FAA Bureau of Research and Development's Experimental Center at Atlantic City. Although Berlin's air traffic is not heavy by U.S. standards, Berlin's space, the need for more modern navigation aids and control equipment and the confinement of traffic to three corridors between Berlin and the West have created problems in the handling of air traffic in the terminal area.

► Sencill's biweekly T-10s continue to show poor utilization after more than four years of regular service. One Soviet source indicates that T-10s employed on the trans-Berlin run average only 150 hr of flying time monthly.

► Northwest Airlines has been making the best of a bad situation resulting from the flight engineers strike which has prevented the carrier's Douglas DC-8s to leave Minneapolis. Three of its DC-8s have been sent back to the Douglas plant for fuel during the strike. These involve installation of landing edge wing tanks and new wiring for these tanks. Northwest's fifth DC-8 will come from the plant with the modifications already completed.

► Air Traffic Conference last week elected William J. Mitchell, vice president of traffic and sales for Braniff Air Lines, president of the conference. William L. Alexander, Jr., Eastern Airlines vice president, was elected first vice president of the organization, and C. Gordon Brown, vice president of Piedmont Airlines, was named second vice president.

## SHORTLINES

► Air France has begun naming Sud Aviation Caravelle turbojet service from Paris to Prague, replacing Vickers Viscounts on the route. The French carrier recently took delivery of its 20th Caravelle and increased its order for the twin turbojet from 27 to 33.

► Air-Liaison International has been recommended by a Civil Aeronautics Board examiner for airport rights at Chicago, San Antonio, in flight from India to the U.S. Thailand also is served by Trans World Airlines, which had no objection to ending Air India's in the South Asian market.

► Braniff Airways inaugurated an all-cargo service last week between Dallas and New York with Douglas DC-6A equipment. The airline has organized a new cargo unit and service department to put new emphasis on cargo and freight activities.

► Capital Airlines was authorized by the Civil Aeronautics Board to expand service at South Santa Maria, Chile, and Tijuana City, Mex., Dec. 1 when North Central Airlines began serving the three cities. Action was part of the decision in the Great Lakes Local Service Case.

► Continental Air Lines has asked the Civil Aeronautics Board for airport rights between several Texas cities in the Southwest Local Service Case hearings now in progress in Washington. Continental is asking for authority between Dallas/Ft. Worth and Houston and Dallas/Ft. Worth, Austin and San Antonio.

► Federal Aviation Agency has organized an Airport Planning Planning Section to develop technical guidance for civil airports participating in national emergency plans.

► Mohawk Airlines has been recommended by a Civil Aeronautics Board examiner for indefinite rights to operate overnight between Montreal and New York. The recommendation follows a trial period of three years during which Mohawk's participation in the airport Security New York market rose from 6,033 to 14,816 passenger enroute.

► Montreal International Airport opened its new \$30 million facility last week. The new terminal complex and a new 3,700-ft runway will serve the four Canadian and eight international carriers operating from Montreal. Eastern Air Lines and Northwest Airlines are the U.S. carriers operating at the airport.



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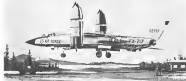
**THE KAMAN AIRCRAFT CORPORATION • BLOOMFIELD, CONN.**



**ARIA-BUILT** Isotape of the Bell D-188A Mach 2 V/STOL tactical fighter is shown in runway mode; built by Bell. Note the variable wedge that separates the ribs of the two General Electric J85s located in the right wing tip section.

## Bell Reveals D-188A V/STOL Details

By David H. Hoffmann



**D-188A** engine nacelles in V/STOL flight engine nacelles forward about 10 in. to move forward engine nacelles for vertical takeoff. Wingtip nacelles rotate from horizontal to 30 deg. forward vertical to support the forward flight nacelles vertical thrust or landing action. Rotation of nacelles toward horizontal closes secondary air intake.



**ALUMINUM** plates capable of quick assembly could form the landing gear for vertically dependent D-188A. Box at right is artist's concept combined nacelles and their wheel, when integrated by the fighter's wheel, gear nacelles and stabilizers of the landing gear. Series of trusswork which was in the background fold flat. Bell found that aluminum and steel, treated with zinc compounds, could serve as a D-188A landing gear.

**Tulosa, N.Y.**—Development of the Bell D-188A Mach 2 V/STOL tactical fighter, named beyond Bell workshop stage by a \$17 million government-contract, is now being on Bell's success in winning military interest in the aircraft.

Looking from an industry competition to design a dock-ready intercepter for Navy and a former Air Force requirement for a V/STOL fighter-bomber (AWM No. 14, p. 26), the D-188A project, Bell believes could produce an operational evaluation as early as 15 to 20 months.

Bell maintains that the aircraft aircraft, in one sense a prototype, would be beyond all small V/STOL designs in performance. Powered by eight General Electric J85 turbojets developing a total thrust of 15,000 lb. on takeoff, the D-188A could:

- Climb at least 60,000 ft. in 30 sec.
- Cruise 600 mph and return while holding Mach 3 at about 35,000 ft.
- Accelerate from Mach 1 to Mach 2 in under 2 sec. at about 15,000 ft.
- Have a Mach 3 turn range of 2,000 feet or more.
- Maintain Mach 2 for 340 sec. on a high speed intercept mission, then return from an altitude up to 60,000 ft. at least twice.
- Take off from a short strip, cruise 170 mph, then fold a Mach 2 tank for 115 mph in before a high altitude bomb drop.

Bell says and Navy has backed D-188A development to the extent of \$14.5 million, with the flow of funds



**FRONT** view of nacelle shows one of the two J85 engine inlets, which incorporate slats, a ridge and stubs, high mounted D-188A wing.

beginning in 1956 and ending in February, 1957. To avoid checking in D-188A design team at five power, Bell received another \$2.5 million—a sum it intends to work off in no less than 18 months—consequently is extended by the military.

According to Bell Technical Director (chief) decision to continue or discontinue the D-188A program is still under review, whether a superior V/STOL fighter of U.S. manufacture will not within the next two years or not until the early 1970s. This inevitable high, some substantiation in current Air Force thinking.

In winter of the mission of the Tactical Air Command Air Force, rapid implementation of Soviet Design Requirements (SDR) 17, which required the and for a Mach 3 V/STOL fighter and supported it with SDR 17, which only for an STOL fighter with a 1,000 ft. takeoff capability and a range of several hundred miles, which, according to below 1,000 ft. at about Mach 1.

### STOL Given Priority

Department of Defense, recently, defined the tasks, directed to the V/STOL fighter to the SDR, aircraft and indicated that those might be in caused. In the light of these technical requirements, TAC headquarters is



**COCKPIT** of the D-188A features a center panel with all engine instruments on its left, for control and monitoring systems on its right and outer displays on its center. All operating controls are on side panels and consoles. Vertical nacelle engine performance gauges on lower left instrument panel show open exhaust gas temperature and pressure of all eight engines. Aircraft altitude just above a cross and other of gauges control engine start that leads to each power setting to show fuel remaining, center of gravity location and remaining range capability.



**PRESSURE** pattern provided by various powerplant configurations is shown above with black arrows indicating the degree of 70 ft. under the V/STOL pattern. When it is shown in speed from one centrally positioned inlet (left) as a reference in pulled in from the intake to create a vortex over the inlet. Corner diagram shows shell structure with wing tip mounted nacelles and an outer wing. Drawing at right indicates D-188A pressure pattern in actual position, with some nacelle effects resulting from fuselage pressure.

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**BULLPUP** made in King, position on one of the dual-mounted engines installed in the D-155A test bed. The dual-mounted engines are held by Bullpups as these Sole writers in combination of these with guide dog a repair.



**THRUST** reverser valve in air engine position straight line after to forward flight, direct exhaust downward for vertical takeoff and landing maneuvers. Note the fixed vertical position of forward side engine in the drawing at left.

periscope STOL aircraft to be on hand in quadrate strength about 1967, with VTOL flight to follow sometime after 1970. In the interim, DOD intends to keep some VTOL "study centers" or "studios" in the industry.

But, on the other hand, suggests that the DOD could be "saved" along as part of the STOL development program at an additional cost of only about 7%. Should the military follow this approach development of a supersonic VTOL fighter could proceed in order, saving, capitalizing on work done in date. Bell explains.

Specifically, the company is seeing Air Force to back the building of 10 D-155As to be used for operational evaluation and to allow funds for a continuing VTOL research program that would include on engine definition, matching study, using cutting hand

work and state-of-the-art material, the 10 D-155As, according to Bell, could be rolled out within 30 months after contract go-ahead.

Chances that the Air Force will endorse the entire substance of Bell's recommendations appear slim, although the company expects that some encouragement was extended on Sept. 12 to Gen. Frank E. Tamm, TAC's commander. Following a Bell briefing, E. Tamm agreed for the first time that the D-155A design concept appeared feasible, even though in his opinion, the STOL or cruise should command a higher budget than present.

Also enhancing Bell's prospects of obtaining new funds for the D-155A is the fact that Air Force has never exceeded SOR-12, its original engine intent for a VTOL fighter. Air Force has on the other hand approved



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ing fuel raised on jet-powered wing tanks, the fighter would loathe down at their own side into work to depart on a combat mission.

As the degree of D-188A disposal is increased, the cost of operating the aircraft should drop, for fuel becomes less and a modest amount of ground support equipment must be prepared at the disposal site to ensure combat capability.

But scale capability. Bell now rates the disposal D-188A into a far more initial-and, in the long run, cost-effective—weapon system. About \$1 billion, for example, would buy 17 D-188A wings and put three operational and maintenance costs for a year. It depends on scale capability and operation from a central base where could strike and prosecute targets, about 125 potential targets.

Only 5-4 disposal wings could be had for the more \$1 billion. But see and strike capability would so multiply their effectiveness that these could destroy 125 potential targets, explains Bell.

Original D-188A design concept called for a thoroughly integrated weapon system with a maximum speed of Mach 2.5 to fulfill the requirements of SOR 17. Under an agreement with Bell the Career Division of General Dynamics was scheduled to be phase contractor (AW Feb 9 1979 p. 20).

This partnership has introduced, however, into Air Force studies its support to longer, longer ranged S10L, aircraft Bell, as an aircraft based off from the Mach 2.5 weapon system to the plane it now seeks to sell to the military—a Mach 2 evaluation aircraft that would use the modified hardware and propulsion engines.

#### **Thrust/Weight Ratio**

The D-188A's unusual payload configuration dictates several key performance items in design work on the aircraft. One of these is the thrust/weight ratio. Aircraft in this class must have a thrust/weight ratio of 1.0 or greater.

Today, aircraft used for targets such as the B-1 offer the highest thrust/weight ratio available to the industry. About 5 to 1. Not until 1965 Bell produced a new aircraft, the S10L, which had a thrust/weight ratio of 1.0 to 1.1. Left engine engines are close to 1.5 to 1.1 during the test phase, but that doesn't give the aircraft the 1.0 to 1.1 ratio.

The current D-188A's thrust/weight ratio is the result of 17 to 1.1 would be required by a 70,000 lb. gross weight fighter-bomber carrying half its own weight as fuel. A significant lower limit, according to Bell, would be the distance from the disposal system by having its range and payload.

By placing all payload in the D-188A's reconnaissance, Bell found that it could take full advantage of the value offered by the B-1's about 7 to 1. Thus the lighter weight of gravity (GG)—where, pound for pound, had lost weight balance—left open the road to a heavy but loaded by the plane's CG and spacious enough to hold a large B-1.

Design also demands much of the weight ducting ordnance found in a fighter's fuselage. Thus, carrying ordnance thrust/weight ratio. Of equal or greater importance are the optimum underweight pressure patterns that form when the D-188A operates in the VTOL flight regime.

#### **More Powerful J85-5**

In going for D-188A's expected performance, Bell is banking on a somewhat more powerful version of the J85-5 than those that have entered service to date. That such engines will be forthcoming is supported by General Electric's static tests, which indicate that substantial growth potential is inherent in the compact J85 powerplant.

For example, an afterburning J85-5 rated at 5,000 lb. thrust currently produced more than 4,000 lb. thrust during the manufacturer's qualification program. "Dry" output of the engine, rated at 2,500 lb. thrust, was boosted to 2,600 lb.

That engine thrust output exceeds the maximum gross weight of a VTOL aircraft with absolute limits, for by design the VTOL platform must break ground while accelerating forces are less. With the "Jet Test Vehicle" and the X-14, two earlier VTOLs designed and flight tested by Bell, has convinced the company that conventional engines are well suited for both vertical takeoff and to meet maximum demands imposed on a VTOL engine booster.

To design new turbofan or turbojet engines for VTOL aircraft because such powerplants offer improved specific fuel consumption, probably in excess of 100% over conventional engines. This is according to GMV's, is because the performance such powerplants in the average new turbofan's 10% better fuel economy can be achieved by 10% increase in the thrust output of standard turbojets on a VTOL.

A thrust increase in the range would enable a VTOL aircraft carrying 15% of its gross weight in ordnance to load 15% of its weight in more fuel to extend its cruising radius 10% without need to radically changed powerplants. GMV's maintains, adding "A 10% augmentation of thrust that produces approximately 40% more ordnance load is much equivalent."

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"In fact the use of a short-time take-off using at about ten minutes, taking maximum advantage of its occupied or overtemperature capability, the engine was shown that the shock is a 10 to 100 performance, during the brief transition from takeoff to forward flight is through the use of horsepower thrust augmentation devices such as water injection to explain.

### Other Problems Solved

Although engines still struggle with the increasing problem of engine and overall thrust/weight ratio, several other V101 problems about equally troubling a few years ago have been solved in full. These involve both the temperatures and the pressure problems generated by an engine cooled directly downward and the erosion of hot of the oils on landing gear.

After more than 1,700 test runs, a jet test stand Bell concluded that engine concerns, back could with stand the 3400°F temperatures produced by the afterburning J75-1 on the D-155A's wing tips for long periods of sustained operation. Moreover Bell found that concerns of an oval shape treated with one of several resin compounds, could serve as a D-155A landing pad. If small aluminum blast plates, just large enough to shield the area of direct engine impingement were placed on the tested stand, no deformation occurred even though Bell's testing simulated hundreds of D-155A takeoffs.

In considering the engine effects of the D-155A jet exhaust, Bell believes the speed with which the results can become airborne is of paramount importance.

Thus O'Malley explains: "The D-155A is capable of starting its engines and performing all payload checks prior to an emergency ejection from the forward fuselage area, allowing ejection. So the concept is not a problem, the engine is made for itself and will start into vertical ascent within two seconds of the time afterburning power is applied. Total time for the aircraft to reach 10 ft is about 1 sec."

With the new test bed, Bell simulated the temperatures likely to result in the area surrounding a D-155A wing up to 100 ft away, post-jet to take off.

In general it found that despite the 1000°F temperature of the wing tip exhaust, actual temperatures taken at ground level did not exceed 1000 ft and a 25 ft radius.

Temperatures measured 50 ft above the ground below 1000°F outside the radius. Thus Bell concluded that high velocities and high temperatures would not exist at the points where jet exhaust strikes the ground under the aircraft.

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WEST GERMAN industry moved to steel boat town port World War II activity when it moved production rights for France's Fregate 1200. Here, large assemblies made by Messerschmitt are being mated with wing and tail sections built by Heinkel.

## German Industry Studies Mach 3 VTOL

By Cecil Browner

Bonn—West German air force is now planning looking beyond the conventional beyond-production aircraft industry is still looking to build, hope to make the next step in a technology battle of VTOLs.

The VTOL program includes the much discussed Mach 3 interceptor, the only one, as yet beyond the preliminary planning stage—a close support aircraft designed to attack supersonic speeds at near ground level altitudes and a transport small enough to be stored in forest clearings but large enough to carry a small ton payload over tactical range distances.

Technical requirements for the close support fighter as a successor to the Fiat G-91 are now being studied in a cooperative effort in Germany, France, Italy and Great Britain. Once the details have been agreed upon they will be submitted to the North Atlantic Treaty Organization for approval.

If such approval is granted, Germany is mounting open a common development and production (also divided evenly among the four sponsoring nations).

One possibility is a successor to an advanced version of Britain's Hawker P-1127 fighter project which West German officials view as a very promising research effort.

If approval can be found on the west side, the same plan will

be followed in the evolution, development and production of the VTOL transport.

With these projects, Germany is strengthening its role in determining the equipment needs of the West European allies as well as building its own industry, placing it in a position to lead as a nation, according to NATO requirements, rather than accepting the lead role of others in the past. These lead and its resultant production will another turning point in the country's return to a leading, if not preeminent, force within the West European nations community.

### F-104G Replacement

VTOL designs to replace the Lockheed F-104G all-weather interceptor and fighter bomber, the G-91 and the Nordtoll T-104G transport will be awarded after the next 6-12 years, West German air force officials said today.

The reason—expensive and as a result to replace open valuable hard-earned money—was obvious and was supported by the U.S. An added factor is that in Germany, with an average of 140 people per square mile, land for airports is hard to find, even harder to obtain.

Development of possible plans for these fighters within West German development circles against the line drawing of the unified cord that has led

new line into a once seemingly dead industry.

The unified cord was and is, a strong production beginning with the relatively simple Fregate 1200 and now progressing to the G-91 and the relatively more sophisticated F-104G. These agreements, plus close contact with other Western powers on the research and development level have helped West Germany bridge the gap created by 11 technological statistics between the end of World War II in 1945 and 1946 when at NATO and U.S. urging, its industry began to emerge again as an entity.

However, for the moment at least, there is no thought of completely severing the cord. German planners are still using their own U.S. experience, preferring to keep research and development projects that have been learned in other rather than remaining fearful a step behind in moving open projects suffering even part as some other Western nations have done.

On the business side, the Mach 3 VTOL, for instance, the Messerschmitt Heinkel Helios design group has worked closely with a number of U.S. firms, including Boeing, Lockheed and Martin and is willing to work with them, if they have something to offer.

The team also recently asked Bell Aerosystems Co. to contribute its design experience from the supersonic Bell D-558-2, a "P-56" which has reached the workshop stage before the first of

U.S. Air Force development funds was halted in early 1959. The variable sweep concepts for high-speed VTOL vehicles evolved in National Aeronautics and Space Administration's Langley Research Center (AIAA, Apr. 4, p. 12) have been extensively reviewed.

In preparing its interest for the NATO comparison, the group has reviewed well over 100 VTOL designs and concepts.

In another effort to move fast, the group hopes to adopt USM's "Mile or Run" principle, extending it beyond national borders, and it is planning the aircraft as a whole around the weapon system concept.

For an independent example of the scope of its "Mile or Run" concept—the group is evaluating costs from five companies representing three nations, including the U.S.'s McDonnell-Henrichs, Lear, Inc. and Perkin-Elmer.

Dr. Robert Lauer, technical director of the group located in a section of Messerschmitt Daimler-Benz, worked for Messerschmitt before and during World War II on various projects in the Me-109 line moved to the U.S. to conduct research work at the Navy's missile center at Ft. Meigs, Calif., and later at the Army Ballistic Missile Agency in Huntsville, Ala. Apparently, he made two years ago with U.S. financing and as an American citizen, he returned to Germany to head the Mach 3 design team.

### Breaking the Gap

Original design work in Germany plus its growing industry do not necessarily mean an end to major aircraft procurement elsewhere. The air force training command is anxious for an aircraft to break the gap between the Magister junior trainer and Lockheed's T-33 basic trainer on the one hand and the G-91 and F-104 on the other.

Present planning, for example, calls for pilots to move directly from the Magister to the G-91—a large step. U.S. initiatives with some student pilots trained on the French aircraft Dassault considers that the costs have difficulty, transforming because the G-91 is "too easy" to fly and tends to be a false sense of "jet experience" could develop. The instructors, stronger, prefer students coming to them from North America's World War II B-6 trainers who have never flown a jet before stepping into the cockpit of a B-35.

One possibility being considered to fill the gap between the Magister and the G-91 of necessity can be based on the G-91's T-33. So long as the supply holds out, the air force will select only seasonal operational jet pilots for F-104 training.

The air force also has obtained rights from Sikorski Aircraft Division of



GERMAN air force interceptors, all with a minimum of 250 hp, an operational jet aircraft, are now being trained on two other versions of the F-104. They, in turn, will train the more than 1,000 pilots needed to man the all-weather F-104G interceptors fighter to be built for the air force under license in West European factories.



NAVY TOOL industry also is making a rapid comeback in West Germany. Hydraulic press above is being used to stamp out parts for the Fregate 1200 and Fiat G-91.

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United Aircraft Corp. for the Bremen firm of West Flugzeugbau to build two German prototypes of the turbine-powered version of the S-44 Pylar Gasser. If the new vehicles meet German expectations, other projects will be built here under license for use in the air force as personal transports and cargo carriers. Production also may later be extended to turn out S-44s for Army and Navy use.

German officials have made studies of the S-44 powered by a two-turbine installation of Pratt & Whitney JT1D 12A1 powerplants of 4,350 shp each and by two and three-engine variants of an advanced version of General Electric's T64 with 2,850 shp each. Which one engine is chosen, the German government probably will purchase it directly from the prime source rather than asking for license rights.

### Missile Production

Although working within the NATO framework on production of missiles and components in the near-future time range—the air-turbo-rocket and the Hawk low-altitude sub-sonic missile—West Germany now apparently has no plans to get involved with the development of larger vehicles in this sort.

Dr. Theodor Bredtke, chief of West German air force research and development says that for the present, "we have no requirements of our own in this field. We are only following NATO recommendations. We do not go out and say, 'we need these and these orders'."

Before and during World War II Bredtke adds "our experience was great in this area, but now the U. S. and United Kingdom are much ahead of us and we're following their lead."

The West German government, however, is establishing an Institute for Space Flight within the German Research Institute at Muelheim-Ruhr. The institute, Bredtke says, should be completed in one and a half years with a National Aeronautics and Space Administration laboratory rather than with NASA itself.

After research is launched and other fields waiting in collaboration with NASA, the institute will determine if it can make "some special contributions" in the Western space program.

But, thus far most of West Germany's effort has gone into manned aircraft, and Dr. Bredtke says the air force and industry have moved almost hand-in-hand in their progressive steps as new built were reconstructed in early 1955.

In the first step, former Luftwaffe pilots, recruited by U. S. Air Force instructors, began flying again U. S. equipment available in the military S-54 series. At the same time, industry began



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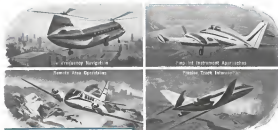
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managing its loads with the licensed production of the Magister trainer.

The second step is now at hand—licensed production of the F-104 and G-91, but with each returned to fit the specific requirements of the German air force. The G-91 is F-104G, Dr. Bercker says proudly. "It's for Germany."

Third step of course is original development work on the "VTOL" family, which may lead to West German pilots flying single German developed and produced aircraft. In the field, Dr. Bercker emphasizes that the Germans plan to continue to work closely with France and Italy, each bringing out special solutions, and with British industry. The West Germans and British already have created an agreement whereby Rolls-Royce, Ltd., and MWM (Munich's Linde Ag) have teamed up to work on the joint development of an advanced prototype package for the M26 VTOG.

Dr. Bercker as chairman of the NATO Air Committee formed to establish future requirements, French leaders in the need for short, distant "VTOL" solutions to carry out the sides of interceptors, close support and transport. Although he admits that at least one of his colleagues "is not yet convinced," Bercker believes that development of a multi-engine aircraft would result in an overly complicated vehicle with

at least marginal performance in each of its fields.

West German officials also hope that, despite recent backlogs in French-German relations on top political levels, cooperation among the industrial status quo continues, and improves.

As to the potential benefits they are particularly the cooperative program now being launched out since for the license European production of the F-104G by Germany, Belgium, The Netherlands and now Italy (AW Nos. 21 p. 26).

### Technical Delays

Technical delays in the production of the F-104G—which as an aircraft with sophisticated electronics, radar, and fighter-bomber is a more modern aircraft—will be in the performance of some of its components in carrying a distributed in total production troubles. And with the first German produced F-104G scheduled to roll out in December, 1961, at the latest, the air force is going to be well south of its goal of 1,000 combat jet aircraft by 1962, or 1963 at the latest. The most optimistic date, now seems to be the mid-1960s.

Dr. Bercker as chairman of the NATO Air Committee formed to establish future requirements, French leaders in the need for short, distant "VTOL" solutions to carry out the sides of interceptors, close support and transport. Although he admits that at least one of his colleagues "is not yet convinced," Bercker believes that development of a multi-engine aircraft would result in an overly complicated vehicle with

with multi-engine operation. An official Defense Ministry location states:

"The equipment program of NATO in Western Europe has in its defense work from the last few years in planning goals and working procedures. The example of the F-104 has now demonstrated the fact that with some good will on the part of all parties concerned in the defense of the West European NATO nations and that such action also produces favorable economic and political results."

And from the technological gains achieved, the F-104's development program are giving a substantial economic boost to the West German aviation industry as a whole.

Starting from scratch in early 1956, when through winds of World War II Europe had nearly broken down and the industry had built itself back to an estimated 14,000 employees—11,000 in aircraft firms, 1,200 devoted exclusively to engine production.

Consumer goods, which now sell guns a new industry at a total of 35,000 people—20,000 employees in 9,000 in aviation industries.

German firms involved in F-104 production are the Siemens Group, Messerschmitt, Heinkel, Dornier and



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Seibel—who will build 210 aircraft with Messerschmitt responsible for final assembly and flight test. The Northern Group of Focke-Wulf, Humberger Flugzeugbau and Wehring which will build two "Netherlands" planes in Germany out of 375 airplanes, and BMW-Triebwerke GmbH, which, with Bolkow National FN and Fiat, will manufacture under license the General Electric T73 turbojet engine.

Approximately 210 aircraft are involved in the licensed production of the Fiat G-91 "Dove" which has final assembly and flight test responsibility, will build the center fuselage section, Messerschmitt the fuselage and wing fuselage sections. Humberger will build the wing and tail sections.

Klunker-Hauschild, Ditzel, of Karlsruhe, will build the G-91's Orpheus gas-turbine under license from Bristol Siddeley Engines, Ltd.

Work spread-German requirements—including its engines, had been increased into its basic design. The licensed model of the G-91 also has undergone its share of growing pains. Rollout and first flight, however, are now scheduled for mid-summer 1963.

As a major contributor to both the F-104 and G-91 programs and producer of over 60% of Germany's fighter planes in World War II, Messerschmitt can serve, perhaps, as an index of the German aerospace industry's revival.

Messerschmitt wound up World War II with a staff of approximately 45,000 people and some 100 plants, including its headquarters at Augsburg.

For five years afterward it lay dormant, stringing along in 1955 with the production of electrical switches, makers at its Augsburg plant, 75% of which were destroyed by Allied air raids during the war, and later following up with the manufacture of enclosed, three-wheel radio receivers.

#### Messerschmitt Rights

In mid-summer 1956, it began its ascent to the summit of 1956 when the German government license rights to build the Focke-Wulf jet trainer and Messerschmitt gained a major share of the production, as well as ordered contracts for the air force's T-8 trainers.

Fuselage, including cockpit and electrical installation, final assembly and flight test at the Focke was assigned to Messerschmitt. The completed fuselage, not used assembled at a subunit. Augsburg was then shipped to Messerschmitt's Munich-Riem Airport for mating with the wing, empennage and nose section fabricated by Ernst Heinkel Flugzeugbau. The Turbomeca Marboré jet engines were supplied from France.

Beginning the operation with approximately 500 employees, Messerschmitt

sketches in G-91 and F-104 orders rolled in his shop, rebuilt its facilities and increased its employment in the present figure of 3,300.

The lead in Focke designs are now on the assembly line, the Marboré blue jet disappearing in 60, or the G-91's green and the F-104's gray, and the final section is scheduled to be tracked in Munich-Riem before the end of the year.

In all, the Messerschmitt-Humberger combine will have delivered a total of 172 Magister to the German air force since the first monthly rollout of the production line in mid-1959—another 65 of the trainers were delivered recently from Pöschel-Aschmann in the initial buildup stage.

#### Three Nations

Beyond the Focke come the G-91 and the T-34 then aircraft from three different nations in four years, and, after that, possible fuselage sections for Germany's own Me 35 VTOL.

"I began speaking French," one production engineer says, "one day I'm doing so because 'What the others say English should be much better'."

One forward fuselage section, including cockpit and one rear fuselage assembly of the G-91 already are entering their way along the final assembly line in Augsburg behind the last in Magister and are scheduled to be shipped to Dornier within the next two months for mating with their other components.

When production is in full swing, the production of the G-91 is expected to be about 100 per month.

First rollout was not approximately one year ago and then, Messerschmitt's roll shop has turned out over 2,000 up for G-91 production. It still has another 500 to go. The first gray jet for the T-164 also are beginning to appear from the tool shop, which is in the case of the G-91, has a target of about 2,500.

How Messerschmitt will go in the future still appears to be a question mark. Will it build up its own capacity so that it can handle entire references at an acceptable production rate, or will it build with one or more of its partners in the Southern Group—possibly Heinkel with which it is working on the VTOL? For the moment, no one seems to have the answer. But, certainly, Messerschmitt is looking on its first, almost century in its industry.

BMW offers a similar example in the engine field where it presents it in the underground leader.

First engine out Rapp four cylinder water-cooled engine for World War I aircrafts, BMW-Triebwerke a subsidiary of the famed automobile, had built to a force of 70,000 in 1944, producing, among other things, the



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## THE ASTROTUG

**Tugboat for Space:** Spaceborne scientific laboratories and platforms for further exploration into space are an accepted concept based on established engineering techniques. Components would be fired as individual units into space, on precalculated orbits, and then assembled. To solve the major problems of how men are to live and work in space during the assembly process, Lockheed has prepared a detailed engineering design of an astro tug—a normed vehicle housing a crew of two or three. Once launched, the astro tug will be capable of supporting its crew for a number of days in an environment of suitable atmosphere, and with provisions for illumination and adequate food and water.

The Lockheed astro tug is a completely independent working entity. Personnel need not leave it in space ships in order to work on the project of assembling the space station components. As shown in the diagram, the tug consists of two double-walled pressure vessels, approximately 20 feet long overall and 9 feet in inside diameter. Smuggling rocket motor nozzles are arranged for maneuvering. On the forward end, extending out are four mechanical manipulator arms, with interchangeable "hands" for such specified functions as gripping, welding, hammering, cutting, running screws, etc. "Hands" can be changed by remote control from inside. Viewing ports provide uninterrupted observation. Radar antennas, searchlights, and other equipment necessary to the tug's work are mounted externally. Main controls and instruments including radar, radio, infrared, computers and navigation consoles are duplicated in each of the two major compartments as a safety measure.

Men working in single units aloft in space suits would have little applicable force and could work for very limited periods of time. With the Lockheed astro tug personnel could carry on the work in relative safety and comfort with maximum efficiency. A special rescue vehicle, separate from the astro tug, has been conceived for ferrying to and from each. Tugs themselves would remain floating in orbit indefinitely, being rejuvenated and refurbished as fresh crews arrive in relief.

Space vehicle development is typical of Lockheed Missiles and Space Division's broad diversification. The Division possesses complete capability in more than 40 areas of science and technology—from concept to operation. Its programs provide a fascinating challenge to creative engineers and scientists. They include: orbital mechanics, computer research and development, electromagnetic wave propagation and radiation, electronics, the light sciences, laser engineering, supersonic aerodynamics, man in space, instruments and processes, applied mathematics, oceanography, operations research and analysis, atomic, nuclear and plasma propulsion and exotic fuels, sensor, space communications, space medicine, space navigation, and space physics.

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*Says* L. G. ROSEFELD, Superintendent of Communications, Delta Air Lines

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Model 109 605 turboprop engine for the McDonnell 252.

Of the seven plants they maintained during World War II, they have no longer possessed of one located at a remote section of the Munich suburb of Munich-Allach.

In recent years, however, in 1984 when BMW established a study group to see just what could be done and in which direction. In 1985, with 170 employees, BMW began looking for the licensed production of 250 hp, 3-cylinder, DOHC 136-piston engines for the BMW 3 Series for the 510i. The 27-cylinder plant and to Fuchs, Wolf for German-produced versions of the Pugsley 1400, 1600, 1800, also built under license. The same time, it began to produce all engines in 1986.

Taken with over 1,000 employees, BMW is preparing to build components for the 19 in collaboration with its Belgian and Italian partners and a licensing plan for assembly and overhaul of all engines scheduled for the 1986 of the German or later. It is still building and overhauling the Licensing and has an overall contract from the West German state for the manufacture of Continental Mark II and Mark II-414 engines.

In addition, in May 1986 began to gain new jet experience by evaluating the Conquest engines for German air forces. Since its birth in Canada. At the air force, and BMW gain experience with the engine it is now added as a certified aircraft engine 300 hp is expected to the 400 hp figure for the Royal Canadian Air Force. An experience is gained however the figure probably will be probably increased to 400 hp.

BMW executives on their standards, focus on the design and production of small turbine engines plus the continued licensed production of large piston engines and in the 19 to gain the experience with before can looking upon their own.

### New Turbine

Their development group already has designed a turbo-propeller turbine engine where power is being boosted from the 60 to 100 years ago to 180. Versions of the engine already are being tested in a powered glider manufactured by Alpiques in Germany, and others are being offered for sale. Power or heat exchangers to some very quiet turbo-propeller pumps and powerplants for ship workstations devices.

Within the next year or so, BMW hopes to take a further step with the introduction of a family of 100 to 500 hp direct turboprop for small aircraft aircraft. From these, as the types and designs of the various turbine engines will multiply.

### PRODUCTION BRIEFING

General Electric's Aircraft Auxiliary Turbine Department, Lynn, Mass., has secured a study contract from Lockheed on the use of a lightweight gas turbine system for direct vector control of lift.

General Electric's Small Aircraft Engine Department, Lynn, Mass., has secured an order for 15 CT55-180.2 gas turbine engines from World Electric, Boeing, Arlington, Va. Engines valued at approximately \$1 million, are to be delivered starting in mid-1991 and are to be installed in Vostok 107 turbine helicopters.

Twinn Cook Co., Redden, N. Y., has received a \$66,000 order from Raytheon for electronic modules for the Link surface-to-air missile system.

NASA has awarded a \$105,000 contract to General Electric's Defense Systems Department, Syracuse, N. Y., for radar display and computer equipment. The equipment, to be incorporated into a system called Terminal Guidance and Data Facility, will be installed at NASA's Flight Research Center, Edwards AFB, Calif., for use during tests of the North American X-15.



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### PROBLEMATICAL RECREATIONS 43



A couple 15 inches long will turn 4 hours. 1 inch at the lower end will be consumed in 20 minutes less than the same length at the larger end. How long will it take for an inch at the lower end to be consumed?

—Lester Kline 1981

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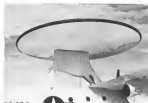
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View from the WZF extends forward and slightly to occupy the middle of the glenoid fossa (enveloping region). Note structure and position described to a lateral view, caused by the same wheel contact function.

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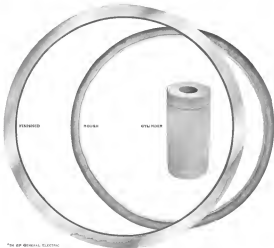
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## WHAT'S NEW

### Reports Available:

Following reports were prepared by the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

**Secret Military Dictionary**—199 page translation in the U. S. Army of Russian operational, tactical and general military terms. \$5.00 (68-2135)

**Photomicroscopy**—Bibliography, lists technical research reports translations of foreign literature and government owned patents available for license. \$10 (68-496)

**Photographic Chemicals and Emulsions**—Research reports foreign technical literature etc. listed in bibliography. \$10 (68-497). List of 208 OTS sales and bibliographies may be obtained on request without charge from OTS.

**Physical and Mechanical Properties of the Cobalt-Chromium-Nickel Alloy** After W172, Defense, Medical Information Center at Biologic Materials Institute. \$50, 21 pp (PB-16124)

**New International Flight Information Manual** issued by Federal Aviation Agency—\$5.55. Area Superintendent at Document, U. S. Government Printing Office, Wash. 25, D. C.

**Cooling Methods and Equipment for Supersonic Aircraft**—G. B. Werth and others, Douglas Aircraft Company, Inc., for WADD, U. S. Air Force. Feb. 1960. \$5.00, 139 pp (PB-161731)

**Instrumentation Package for Inflight Physiological Studies**—M. N. Goldberg and others, North American Aviation, Inc., for WADD, U. S. Air Force. Feb. 1960. \$2.00, 73 pp (PB-161712)

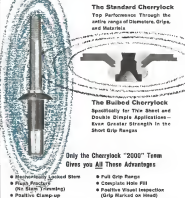
**Synthesis of New High Temperature Materials**—J. L. Finkle and others, Stanford Research Institute, for WADD, U. S. Air Force. Feb. 1960. \$1.25, 44 pp (PB-161730)

**Friction and Wear at Elevated Temperatures**—E. Rubenstein, Massachusetts Institute of Technology, for WADD, U. S. Air Force. Jan. 1960. \$75.25, 25 pp (PB-161719)

**Protective Coatings for Refractory Metals**—C. G. Rogers and others, University of Illinois, for WADD, U. S. Air Force. Jan. 1960. \$1.21, 16 pp (PB-161739)

**Comparative Properties of Heavy High Temperature Alloys**—Hess, Stettin Co., 270 Park Avenue, New York 17

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For technical data on the Cherrylock Team, or more, write Cherry Rivet Division, Townsend Company, Box 2057-N, Santa Ana, Calif.

\*Patent No. 2,975,620

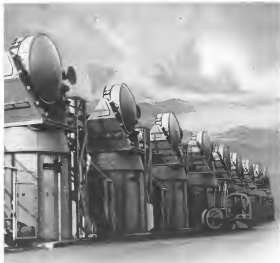
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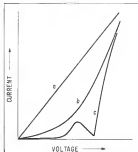
Developed jointly with the Bureau of Naval Weapons, Sperry engineered the design for fast production to meet delivery dates. . . yet controlled the critical quality of these complex, high-performance shipboard radars. Nine units are shown "on the line" above, undergoing final checkout prior to shipment.

The SPG-55 is on duty with the Navy's newest guided missile destroyers, cruisers and carriers, including nuclear class surface ships. Able automatically to acquire, track and guide the Terrier missile to its target, the SPG-55 is part of a fire control complex that incorporates—as well as precision guidance—the most advanced electronics and computational systems, all produced to highest reliability standards, and on accelerated schedule, by Sperry.



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## AVIONICS



**NEW ELECTRONIC** device using recently discovered principle may be the forerunner of an entirely new family of devices. Experimental work shown at left consists of two metal films separated by thin insulator film surfaces deposited on a glass substrate. General Electric discovered that tunnel current that flows through the insulator can be modified and controlled by using superconductive metal films. Detailed study indicates device's working area. Chart at right shows current-voltage characteristics for tunneling through aluminum film insulator using two metal films of superconductivity material: (a) shows tunneling current when two metal films are in non-superconductive state. Next curve (b) shows current when one metal is superconductive and not a metal; (c) shows familiar tunnel diode negative resistance region when both metal films are cooled to superconductivity.

## Tunnel Effect Found in Thin Metal Films

By Philip J. Klaus

New York—Discoveries by General Electric that the tunnel effect found in semiconductor also occurs in certain combinations of thin metal and insulator films when subjected to non-breakdown-type inspections, may lead to an entirely new family of electronic devices.

Present knowledge of the new phenomenon suggests that a single device, produced unexpensively by deposition of thin metal films of nanometre dimensions could provide a variety of circuit functions, including constant capacitor switch diode, rapid resistance diode, and triode.

If subsequent research confirms present optimism the new technique might have much as great an impact on electronic technology as the development of the transistor. The need to operate the devices at near-absolute zero temperatures may limit their use somewhat. GE emphasizes that such devices are not just around the corner, except for research needs.

Ordinarily when two metal plates are

separated by an insulating material, as in a capacitor, no current will flow between the plates when a d.c. voltage is applied across them. This holds true even when the insulator thickness is as small as 0.0001 in. GE points out.

However, if the insulating dielectric is thinned to about one ten-thousandth of an inch, current will flow as a result of what is called the tunneling effect. The magnitude of the current is proportional to the applied voltage, as in a conventional semiconductor valve device.

If thin metal films, fabricated from two different superconductive materials are used in the plates and separated by an ultra-thin insulator, then another phenomenon occurs when one or both metal films are cooled sufficiently to become superconducting.

In a GE report of CP's Research 1 is shown that when one metal film is cooled to superconductivity, but the other is not, the amount of tunneling current is greatly reduced if low applied voltage, but builds up again as the voltage is increased (curve "b").

When superconductivity is dropped for

either or both metal films become superconductive, the tunneling current remains at extremely low, increasing with applied voltage. Thus, like the familiar tunnel diode, it enters the negative resistance region where current falls off despite increasing voltage. Finally, the current increases again and then drops with increasing applied voltage (curve "c").

The discovery suggests that a single device can exhibit three different types of characteristics, depending upon whether both of its metal film plates are superconductive, non-superconductive or in opposite states. Because a magnetic field can cool a metal in the superconductive state, no return to its normal state, it appears that a bridge device can be made in which the signal to be amplified controls the strength of the magnetic field applied to the metal films, causing the tunneling current to be modulated by the applied signal.

Unlike the tunnel diode, the negative resistance effect is independent of the direction in which the current flows through the device. The negative resistance region can be changed by

Engineer inspects Styroflex® cable installed in an antenna array at one of Pacific Scatter Communication System stations shown at right.

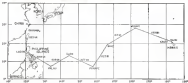


## Over 40 miles of *Styroflex®* Coaxial Cable help assure

More than 200,000 feet of Styroflex® coaxial cables are in active use as balanced antenna feed lines in the recently completed Pacific Scatter Communication System stretching from the Hawaiian Islands to Okazaki. This trans-Pacific system, one of the largest and most advanced of its kind in the world, uses ionospheric and tropospheric propagation techniques that produce over 99% reliability. An important part of the Strategic Army Communications Network (STABCON), the system was designed, developed and constructed by Page Communications Engineers, Inc. for the U. S. Army Signal Corps.

Each of the nine stations in the network is equipped with the same major component parts—transmitters, exciters, isolates, terminals and antennas. The cables used in the 200- and 400-foot antenna arrays range from 3/8" jacketed Styroflex® cable to 3/16" jacketed Fourflex® cable is also used in the system. The Styroflex® cables were spliced in the field by an inert-gas Helarc welding process to assure noise-free connections required for successful duplexed antenna operation.

The extremely low inherent noise level and low attenuation of Styroflex®—together with this air-



## Pacific Scatter Communication System reliability!

dielectric cable's stable electrical and mechanical properties—especially qualify it for the critical specifications of the STABCON system. If your system requires

ments call for a cable with low loss and high reliability, investigate the successful record of Styroflex®!

(Photos courtesy of Page Communications Engineers, Inc.)

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**VOLTAGE** applied to a thin film experimental device is adjusted by Ted Givens, of GE's Research Laboratory. In background is recorder on which several-voltage wave was traced.

verring the transparency of the metal films and/or calibrating them to a meg ohm scale, Givens points out.

Because the several-voltage characteristics are greatly different from those of amorphous or vacuum tubes, the new device will require the development of new circuitry tailored to the new device.

The same was true of transistors with respect to vacuum tube circuits.

General Electric has conducted experiments using films of aluminum, lead, indium and tin, all of which become superconducting at temperatures near those of liquid helium. A sizable number of other metals are expected to exhibit the same effect.

Aluminum oxide has proved as the insulator in most of the experiments, but GE tests indicate that tunneling occurs in oxides, sulfides and nickel oxides.

An attractive feature of the new technique is that it may thin films which can be fabricated in large quantities.

plex circuit configurations in a single series of operations by means of well-known vapor deposition techniques. This suggests that both the size and cost of robot types of equipment, such as digital computers, might be greatly reduced through use of the new technique.

#### Tunneling Theory

The theory of tunneling used to explain the phenomenon is based on semiconductor but not precise adjustment to explain the phenomenon in metals, GE says. Nor is the basic mechanism responsible for superconductivity fully understood. It is, therefore, not surprising that scientists have some difficulty in explaining the effect produced by the combination of the two.

Present knowledge indicates that the tunneling effect is best explained by considering electrons as waves rather than particles. Their electron waves tunnel through metal's conduction, but

when they encounter an insulator they are reflected after penetrating a short distance into the insulator. If the insulator is thick, the electron wave is absorbed in one inside the insulator, but if the insulator is extremely thin, a portion of the wave can penetrate through it and emerge from the other side.

The small fraction of electrons that pass through is said to "tunnel" through. The thinner the insulator, the larger the fraction of tunneled electrons (current) that pass through.

The fact that current results at extremely low temperatures become steady perfect (flowless) electron conductors, and tend to resist penetration by magnetic fields providing the latter do not exceed a critical strength, has been known for some time.

Another, less well-known property is that metals in a superconducting state will reflect electron waves whose energy levels lie in a narrow range called the "energy gap."

This means that any electrons in one metal film which have energies equal to the "forbidden" energy levels in the other metal film will not be able to tunnel through the intervening insulator. The particular forbidden energy gaps that exist in the metals used have a significant effect on the tunneling currents that can pass through the insulator. It was this effect that Givens discovered in the course of his experiments.

If superconductivity is destroyed by raising the temperature or by application of a sufficiently strong magnetic field, the forbidden energy gap disappears and tunneling currents can then flow. If the electron waves can be given increased energy by applying a higher voltage across the plates in order to prevent tunneling currents to flow, according to Dr. John C. Fieber of GE's Research Laboratory.

Dr. Gene Seitz, GE vice president and director of research, calls the new technique "an investment in flexible devices" which is "so recent that all of its consequences are not yet fully determined."

## C-W Optical Master Studied for Space

Dallas, Ohio—Sea-pointed transmitters employing a continuous-wave optical master will be the goal of an ongoing program being initiated by USAF in an effort to establish the applicability of recently developed optical means to space communications.

A contract expected to lead to the development of an experimental optical master transmitter along with an appropriate antenna is an integral part of the



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A 60 HONEY SYSTEM antennas feature curvature tolerances of  $\pm .005$ ".



**Martin-built Pershing**—a major breakthrough for the Army in its program to develop the modern missile as a mobile field artillery weapon. Pershing rises over the rugged terrain on its own mobile launcher, is ready to fire within minutes.

PERHING—in test of Corps Concept

**MARTIN**

## IMPORTANT NEW ENGINEERS FOR CREATIVE ENGINEERS

The Martin Company, at Orlando, Florida—prime contractor for Pershing, Balzers, Escamot, Missile Master and HARBOR—has senior level openings on its Technical and Research Staff in the following technologies:

- **Operations Research**—including systems design and production methods for existing and proposed weapon systems.
- **Information Theory**—with emphasis on optimum coding and signaling techniques.
- **Digital Computers**—analysis and advanced research, including learning machines.
- **Electronic Systems**—conceptual evaluation of advanced weapon systems.
- **Inertial Guidance**—conceptual and analytic investigation of advanced systems using novel components.
- **Electronic Packaging**—utilizing thin film and micro electronic technology.
- **Environments**—study of shock, vibration, acoustics, temperature, and natural environments.
- **Structures**—development of new concepts, materials, applications, and design criteria.
- **Human Factors**—analysis related to military and space applications.
- **Missile Propulsion**—liquid and solid rocket propulsion and air breathing systems.
- **Ground Support Equipment**—with emphasis on mobile missile systems.

If you are qualified for senior level work in this highly select staff, please send a brief resume to Mr. C. H. Lutz, Director of Employment, The Martin Company, Orlando 22, Florida.

WORK IN THE CLIMATE OF ADVANCEMENT

**MARTIN**  
ORLANDO

AVIATION WEEK, December 5, 1960



transmitter system will be installed by the Air Force in mid-December, improved system have indicated.

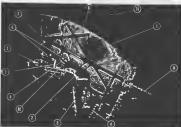
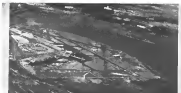
Eight companies attending a recent "buddy" briefing held at Wright Air Development Division listed Air Force outline its requirements for the space communication system. The eight were Bell Telephone Laboratories, Electro-Optical Systems, General Electric, General Precision Laboratories of General Precision, Inc., Hughes Research Laboratories, ITT Laboratories, Northern and Technical Research Group.

Although technical people from as few of these companies presently expressed doubt about the feasibility of meeting USAF requirements for the optical space transmitter test form present at the briefing are believed to

have subsequently submitted system proposals.

Essentially, Air Force desires a transmitter in which an optical master will be both a source of continuous wave radiation and an amplifier. Power for the master is to be supplied by the sun's energy and will be collected and concentrated by a light-collecting mirror (collected portion of the type provided to WADD under a separate solar communication system contract (AW May 2, p. 64) by Electro-Optical Systems).

Optical master operated by Hughes and Bell Telephone Laboratories (AW Oct. 24, p. 75) supplies flash tubes as power sources and provide pulsed output. Required radiated power density for the USAF-derived device along its axis of intensity is to be greater than



## Taxi Radar Outlines Washington National

This aerial view of Washington National Airport, as seen by newly installed Airport Surface Detection Radar, the third of 10 scheduled installations at major airports, shows extremely high resolution of the equipment produced by Aerospace Instruments Laboratory. Radar scope photo below aerial view of Washington airport, shows (1) taxiway, (2) main terminal buildings, (3) north terminal building, (4) parked aircraft, (5) tracks of aircraft moving in parking ramp, (6) tracks of aircraft landing on main runway, (7) runway lights, (8) approach lights, (9) hangars, (10) tracks of moving fuel trucks and (11) navigation buoy in Potomac. Radar was developed for Federal Aviation Agency and Air Force.





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## WHAT AN IMPROVEMENT IN RADAR PERFORMANCE!

This new Video Correlator is now available as a plug-in unit for fire control and search radars both airborne and ground-based. Flight and laboratory tests have proved that this compact, 0.3 cubic foot radar augmentation device • makes target detection certain • serves as an effective counter-countermeasure • reduces interference from other radars • eliminates external and self-generated radar noise.

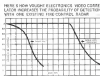
Vought Electronics designed the unit for easy back fitting into existing systems. It contains its own power supply and requires only a simple rigid mounting somewhere in the aircraft.



FOR FURTHER DETAILS ON ANY ONE OF THE MANY APPLICATIONS OF THIS RADAR ENHANCEMENT DEVICE, WRITE:

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also obtainable by direct reflection of sunlight energy.

Should the sun-powered transmitter prove feasible, it will mean that some one else the failure of optical laser projects (AW Dec 14, p. 87) who has located the device's unusual characteristics for space communications and radar. For such purposes, this point out, optical laser systems would be highly directional, yes; but, capable of transmission over immense distances, and possibly require little power. Use of the sun as a power supply, in source of pump power, would additionally amplify and lessen the weight of the device.

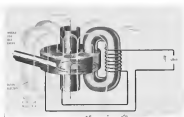
Northern the output bandwidths and the output frequency was specified in the USAF request. Input or pump frequency will be in the solar spectrum (which includes infrared, ultraviolet and visible wavelengths), possibly, in the visible and like those of other optical lasers already operated because this program will use ultraviolet laser development itself.

Several of the firms at the bid list include, including Bell Laboratories, Hughes and Tyndall Research Group, are known to be looking at a variety of materials which could convert optical laser operation into infrared or other laser regions. But it is not known whether the pump power spectral requirements for these materials are met in the solar spectrum.

The USAF, in several, installation program will be divided into two phases. Phase one • Phase II—Design, fabrication and testing of the transmitter.

While modulation of the sun-generated optical output will be of concern, modulation techniques will not be stressed in the program. Output power demands of the transmitter will be 10 watts per square inch when using a collector mirror of one square meter.

Previous Air Force funding of optical laser development consists of a \$4-million follow-on contract from the Air Force Office of Scientific Research with Tyndall Research Group, Bristol, N. Y., a \$75,000 WADD contract (AW Feb 18, p. 85) with Hughes Research Laboratories, Malibu, Calif., and a very small effort at Columbia University in New York. In addition, Electro-Optical Systems, Pasadena, Calif., is nearing completion of a near \$1-million air use program for the development of a soft communications system using sunlight as the direct illumination source (AW Jan. 4, p. 15) and General Percey, Laboratory holds a \$75,000 Rand Air Development Center award (AW Mar 14, p. 74) for investigation of photovoltaic techniques in solar



## Magnetohydrodynamic Power Generator Developed

Usual magnetohydrodynamic power generator developed by Thompson Research World, will be further investigated under a new contract awarded the company by National Aeronautics and Space Administration. Designed to operate over a wide range of power levels from a few kilowatts up, the device is called a vortex magnetohydrodynamic power generator. Possible applications for the unit, is known for the company, include its use in a manned space vehicle as a source of electricity power in an intermediate duration time to two solid power sources, and as a source of short term bursts of extremely high power output. As in other magnetohydrodynamic power generators such as the one developed by General Electric's Research Laboratories last year, the Thompson Research World unit depends upon the conversion of a hot plasma across a magnetic field to induce an electric current between two electrodes. In effect the hot gas replaces the anode and cathode of a conventional gas generator. Unlike the other General Electric device, the Thompson Research World vortex MHD power generator is designed so that the gas particles will become spent prior to the magnetic field. This simplifies the design of the gas, according to TRW, engineers anticipate the utilization of the magnetic field increasing the power output/weight ratio of the generator.



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- **DRONE**  
*Proven drone capability*
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*Minimum development cost, cost of maintenance*

## ARMED RECONNAISSANCE

1. For the U.S. Army

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Log in between infrared and ultraviolet. The latter shows processes use of incandescent replediscent light source (AW Feb 22, p 47). Northern Santa Barbara, Calif. is Lucas to build Signa Corp. contracts for active infrared system development and Thermal Optical Capital (pubs) has been given government funds. Other techniques for generation of infrared light in under study with Air Force funding.

**FILTER CENTER**

**Microfilm Committee on Age-Related Issues** that initiates projects on aging, intergenerationalism, and interfaith studies (such as research and development programs on disabilities, elderly care, and aging). Several recent requests for proposals are on research needs in Wright Age Development, Demography, Economics, Health, and Education. Research grants that encourage the study of

► **Semiconductor Preparation**—Single-crystal germanium is being produced supported on single-crystal substrate materials at Levi's Solid State Physics Laboratory, as part of the company's microcomputer program. Germanium dots can be accurately controlled by the



### Infrared Relay

It comes from the Division of Daytime, Inc., has developed an ultra-compact, disposable infrared, unattended water loss detection system, changes adjustable for testing devices. Model 5121 can be used at a distance from hot burning point until the infrared water vapor, taking up with passing, causes infrared detector connection. Unit requires no wiring outside.

thickness between 200 angstroms and one micron and can be precisely placed on the substrate. Crystal structure of the substrate is the same as that of the semiconductor and epitaxial order, possible in truly epitaxial growth, is maintained. In addition, dielectric properties of the substrate permit use of crystal structure of passive film oxides.

**•** **Highlength's** **Wenters-Bell** Highlength's will soon award a contract for design and construction of a research generation breeder reactor using schedule as part of the Army Navy Instrumentation Program. Needles and General Electric are among the bidders.

[illegible]

► **Filter Feeds Redesign—**Then there was this fire across the lake, which appears to have washed leaves down of dead, dried, redwoods in several beds conducted by scientists at the Franklin Institute. There is a need to confirm belief of this fire spreading that so all environmental area would enable the fire to be serious to other waters.

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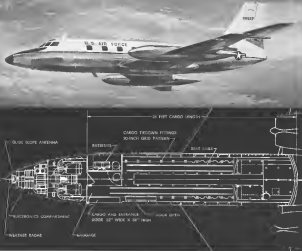
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Quoted and tempered N-A-XTRA, the best low carbon ultra-strength alloy steel you can buy, has available in four levels of minimum yield strength, from 102,000 to 110,000 psi. They are tough at normal and subzero temperatures and can be easily and reliably welded. Sizes range from 3/4" to 2" thick, up to 12" wide and up to 15' long.



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The Lockheed C-140 JetStar's high speed and long-range capability give it a much higher rate of productivity for mission support than aircraft now in service. The C-140 is versatile; its pressurized cargo compartment provides flexible arrangements to transport passengers, priority cargo, or specialized equipment. And the C-140 is economical; the modernization of mission support fleets—by replacing obsolete aircraft with JetStars—can save millions of operational dollars.

# LOCKHEED

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components in solution environments. Such failures could have an important bearing on the design of some equipment for space projects, especially some long life life-support systems and satellites which will be exposed to appreciable total ionizing dosage over long periods in the Van Allen belts. These films have been regarded as promising for aerospace applications because of their light weight, small size, low power requirements and ultimate reliability.

### NEW AVIONIC PRODUCTS

• **B-11 Meter, Model 6118**, graphically displays the histogram loop of type or segment on an oscilloscope. Direct reading calibrated steps of sample time from 1 to 1,000 microseconds with a maximum sample chamber diameter of



1 in. The meter can measure current time and temperature or act as an integrator panel. Meters can be produced at \$2,000 each on a 45 day delivery basis. Manufacturer: Scientific Atlanta, Inc., 1163 Peachtree Rd., N.E., Atlanta, Ga.

• **Shield voltage sensitive magnetron, Type Z-5425**, provides minimum of 1 milliwatt CW power frequency range of 5.5 to 11.1 kmc. Tuning rate is 5 mc per volt. Minimum input voltage is 2,000 v. The complete RF package weighs 4 lb and can be conduction or mounted at 5 cm dia. for spacing at ambient temperatures up to 50°C. Sample quantity price is \$1,300. Manufacturer: General Electric Co., Power Tube Dept., Schenectady, N.Y.



• **Spring-driven rate gyro, Model BUC14**, reaches operating speed within 100 milliseconds after electro-mechanical or pneumatic actuation. Intended for use in expendable drones and rate gyro operates over temperature range of 0 to 150°C, up to 25,000 ft altitude and reportedly meets MIL-E-5273 vibration requirements. Gyro weighs 15 oz. Manufacturer: Fluorobility, Inc., 1501 Camino St., San Diego 6, Calif.

• **Electronic laser voltmeter, Model 1173**, capable of measuring d.c. voltages in the 0.10 v range or as high as 0.50,000 v, has an input resistance of 10<sup>10</sup> ohms measured and draws no current. Accuracy is within 2%, stability is better than 2% in 24 hr at any load temperature, and repeatability is



quoted at 1%. Instruments can be used to read capacitor voltage without discharge or peak value of transient pulses, among other applications. Manufacturer: B. K. Sweeney Manufacturing Co., 6400 Post 44th Ave., Denver 16, Colo.

• **Altitude control transducer, Model 9468**, designed for altitude control applications where its small size, ruggedness, low threshold and high sensitivity are desired. Sensitivity is 4 sec. ±2%

per ft. threshold is 4 ft. at 60,000 ft. Overall dimensions are 3.25 x 4.15 in. Transducer provides a.c. output, operates from -55 to 150°C and is suitable for use in aircraft autopilot systems, fire control and down guidance units. Manufacturer: Calspan Controls Corp., 1608 S. Mountain Ave., Downey, Calif.

• **Target RF attenuator, Model TAD-50**, provides zero to 99 db attenuation in one-half steps at frequencies ranging from 0 to 1,250 mc. Two knobs permit setting of attenuation in decade and read values with total attenuation read out as a ten-digit number. Accuracy is quoted at 0.1 db at 100 mc, 0.5 db at 500 mc in the 0-10 db



range. Above 30 db, accuracy is 2% plus/minus 0.2 db up to 300 mc and 1% plus/minus 0.5 db at 500 mc. Insertion loss is 0.4 db up to 100 mc, 0.4 db at 500 mc. Power rating is one watt. Price is \$775 in single lot quantities. Manufacturer: Telco Industries Inc., Brook Grove, Ind.

• **Substrate operational amplifier, Model 1801**, provides high gain, wide bandwidth and chatter stabilization. Total d.c. gain is greater than 750,000, frequency response from d.c. to 300 mc. Input drift is 1 mv/°C change, out



put is ±10 volts at 4 mA load current, ±15 volts at 2 mA. Amplifier measures 34 in. long, 31 in. high, 1 in. thick. Price is \$400 and delivery can be expected in 45 days. Manufacturer: Davco Scientific Co., 850 Caliente St., Concord, Calif.



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## FINANCIAL

### Martin Proposes Stock Split

Martin Co. shareholders will be asked to approve Jan. 9 an increase in authorized capital stock from 5,000,000 to 12,000,000 shares to provide for a 2 1/2:1 stock split and for future acquisitions.

Until now, Martin's acquisitions have been on a cash basis. Inside Martin, long-time stock of General Precision Equipment Corp., but its suggestion of a candidate for the GPE board was not acted on.

Since then, Martin has not been open to inquiries on GPE stock, but it has been buying shares into Nuclear Corp. of America. It received options in September for 107,000 shares to bring its holdings to 73,100 shares. Martin was announced in the addition of David A. Thomas, former Radio Corp. of America vice president, as Nuclear Corp. chairman. Thomas' former business of Martin also is a Nuclear Corp. board member and so are two other Martin directors.

Martin owned 10% of Nuclear's stock prior to purchase of warrants and now owns less than 6% of the company. It does not have effective control there. Northrup & Co., a New York investment house that underwrote a bond issue for Martin two years ago, also expressed options a month prior to Martin's buying its holdings to 600,000 shares.

Nuclear Corp. has indicated intent of interest to Martin and is doing work at low cost and high voltage electronic tube areas that might be useful to Martin's nuclear operations.

Martin directors also approved a quarterly cash dividend increase from 40 to 50 cents a share on shares now outstanding. Shareholders do not have to approve the stock split itself but the increase is necessary to provide enough shares. Martin now has 5,077,647 shares outstanding.

### Northrop Stresses System Management

New York-System management capabilities in important areas to the aircraft systems contractor as it moves on to the prime contractor, Thomas V. Jones, president of the Northrop Corp., believes.

It is essential in today's environment, he told the New York Society of Securities Analysts, "that a company have the flexibility to deliver either a total system capability or the capacity to handle with the same skill any segment of a system. In the same industry, a company which acts as a system integrator must be able to manage and coordinate the system from the conceptual to the final delivery of the system, including the management of the system's life cycle."

With the growth of technology, Jones added, has come a corresponding growth in costs and Northrop has established a system of subcontracting out at the contract level the management of a concept. It takes the most sophisticated segments to find the simplest solution, Jones said, but the company must provide the desired solution to deliver an easy problem at a sustainable cost with few losses.

One way Northrop sells this capability is in subcontracting technical people with the requirements of low cost and non-technical people with knowledge of technology, Jones said.

Nothing has put a spotlight on its cost control program to me, he said, he said. Northrop's program is a part of the Defense Production Act and is a Defense (DAPC) program of a kind to other companies in the field.

In the past, Jones said, technical skills were largely unmanaged and assigned to a single end product in common use. Now, under Northrop's system, technical areas are separate fields to be managed developed and exploited as a source of business beyond the immediate project at hand. The company is engaged in annual fundamental technical ca-

pacilities, he said, not projects. Northrop's development money has been aimed at strengthening individual technology areas and by such diversification the company hopes to reduce the financial risk often experienced in the defense industry.

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### Financial Briefs

Some initial post-October optimism in Wall Street didn't encourage stocks in October. But the market has been ranging in its back and forth to be shown before recommending industry stocks as the assumption the new administration will intensify interest in defense expenditures in defense spending.

Thomas Electric Corp., Cambridge, Mass., has announced new financing arrangements which will provide about \$2 million for expansion in the next 12 to 15 months. Financing, which included both stock purchases and convertible debentures, was with a group consisting of Lancaster S. Rodick, Jr., James B. Smith, New York member, Lehman Bros. investment broker, and Peter M. Vanden, a company founder. Thomas Electric's interest is in research and development and manufacturing of direct energy conversion devices.

Bowman Instrument Corp., Ft. Worth, Ind., reported earnings of \$123,416 on sales of \$5,411,572 for the year ended Sept. 30. This compares with earnings of \$281,220 on sales of \$1,144,482 for the previous year.

Mannings Manufacturing Co., Berkeley, Calif., reported a record leading year in building systems and pressure vessels, has acquired Mannings Gen. Products, Inc., Colton City, Calif., manufacturer of power amplifiers, precision controls and electro-mechanical flight simulation tables for testing gyro. Mannings was formerly a subsidiary of Aero Electronics, Inc. Last year, Mannings acquired Sonnet Valve Co., South Pasadena, Calif., manufacturer of automatic control valves.

Litton Industries, Buena Vista, Calif., earnings for the fiscal 1961 first quarter ended Oct. 31 totaled \$2,110,000 compared with \$1,537,000 for the same quarter in 1960. Earnings in the first quarter were \$12,100,000 as compared with \$11,675,000 for the same quarter in 1960.

The Morgan Corp. reported sales of \$51,179,771 and earnings of \$1,023,201 for its 40-week period ending Oct. 9. Sales and earnings for the same period in 1959 were \$40,514,337 and \$1,308,666.

Rohmco Technical Products, Inc., has a gross margin on sales and services of \$11,673,791 for the fiscal year ended Jan. 30, 1960, compared with \$5,168,442 for 1959. Net earnings were \$538,556 in 1959 to \$567,706 this year.

Electron Engineering Co. of Colorado reported net earnings of \$178,000 for the first nine months of 1960 on sales of \$1,384,000. Sales for the first three quarters of 1959 were \$1,124,551. Earnings for this period in 1959 were \$158,000.

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## BUSINESS FLYING



TWIN BONANZA for 1961 has redesigned nose for weather radar alignment, new windows for better vision at alt. when needed.

## Beech Pegs 1961 Sales at \$77 Million

By Bruce J. Bellin

Wichita, Kan.—Beechcraft aircraft sales topped off more than \$77 million during a year in which the company's objective that should be easier to reach than was the goal in 1960, says John Beech, Beech Aircraft Corp.'s president and international distributor and developer operations, during a preview of the 1961 model lineup.

Sales group had over budget the year planned \$80 million in 61 to \$2,418,000. Since 512 million of the total was in domestic sales and approximately 510 million was export volume.

Presumably, according to Beech, Beechcraft sales last year were 1959 was "much more than we had been accustomed to doing. Wichita Beechcraft was producing, building, adding distribution and dealer selling that as a growing market that we were coping it was a good job, but it wasn't outstanding."

Domestically, the company's volume increased 25%. It was one, president Michael G. Newberger, export sales were that nearly cut the new record—118% increase in volume. The General Electric division, General Electric, division of the General Electric Co. had two years in order in that country. The year backlog is \$1 million up 50% from last year.

Indications of how Beech proposes to get its percentage still higher next year.



BONANZA 1961 has large new windows for 15% increase in visibility, control system has been modified. Below is the Viper G-12, which now has new picture window added to cabin.



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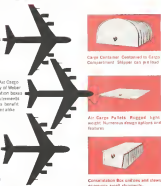
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short during the winter. Highlights in: • Showing of 1961 line, new weathering eight airplanes, with addition of the new lightweight Transport Model 55 Buses (AW Nov. 21 p. 32).

• "Twin-lev" facilities parking program for dealers that is aimed at easing the task of cataloging the sales organizations. Company plans to add some 250 new dealers in the next three years. • Increased emphasis of building parts and accessories business. Beech is only marketing the service bus, and giving a "gold mine" in service business away to franchise without a franchise style in the company. Heavy noted.

Director of the proposed business volume was Beech's 511's million backlog one week after the closing for 1970 of the 1961 sales goal.

These are immediate plans. But some indications of where the company is heading are given. American Wires, the executive vice president Frank E. Hedrick, discussing top management plans on next future airplanes.

• Turboprop engines are the answer to the business aircraft industry's "need to get out of the 200-mph box we have been in," he said, pointing out that turbo-prop changes in power engines are, as so small that hardly enough performance increase is gained to justify their increased cost. Plane manufacturers now need a big increase in power to provide gains in both payload and performance, and the current increases provided by current piston engines make possible slight increases in one or the other, but not in both of any consequence, he indicated.

• Turboprop power will fix the design and build of these performance shortfalls and again bring business plane performance into the area close enough to high speeds which customers accustomed with jet transport travel will consider competitive, plus the smoothness of turbine power that the customer now is accepting is needed.

• Developments in current small turbo-prop models that the transition to these engines will be much less expensive than initially contemplated, in at least one important area. Hedrick said it appears that it will be possible to replace these engines of "recognition level" and power efficiency in the 10-600-hp aircraft, some "he explained, which should immediately pay off in obtaining a significant fuel costs and weight advantage when production.

If it is convenient to lack in high cost of going to passenger cabins, the initial cost of a turboprop aircraft will come into a considerably different cost and aircraft builders should be able to head into this market with much more confidence than they had earlier because lower costs will result in larger possible service and lower financial risk.

Next type of turboprop to be built



DEBORAH has had a useful load increase of 75 lb. New air has been ordered and three more orders are expected this year. Model 55 is priced at \$31,790 an increase of \$1,470.

in Beech will be what is now called around the plant the "King Air"—a Queen Air with turboprop. This airplane would start flying in late 1962 or 1963, according to present planning. Hedrick stated to emphasize the airplane to the new principal, with respect to some of the Queen Air design had thinner wings and new tail.

Next type to be "technized" will be the Travel Air or Raven class light twin, but the schedule on this is not open, though Hedrick said it will follow.

## Beech 1961 Model Prices

Weights, two-night price increases averaging more 4% over Beech Aircraft Corp's 1961 line of eight light and two-engine business airplanes revealed how at the company's usual distribution and dealer meeting.

- Model 55 Buses: a new light twin added in the low five year line at \$18,290.
- Model G15 Twin: Beech adds for \$17,390.
- Model 44 Queen Air adds for \$126,000.
- Model 35A Twin Buses: into the \$400,000.
- Model 1960E: Twin Buses will sell for \$37,290.
- Model 415 Buses: a price at \$25,500.
- Model 418 Buses: will cost \$21,750.
- Model 995 Travel Air light twin, heavily upgraded from last year, will average the more pure to last year's \$24,900.

Beech business plane sales in 1960 1960 achieved an all-time company record of more than 400 million representing a 12% increase over the previous high volume recorded in Fiscal 1959.

rather than provide, the "King Air" class.

In the interim, Beech is studying the possibilities of making the most of the current development by the French Firm, SHERMA, with the Travel Air (AW Sept. 7 p. 122). SHERMA representatives scheduled week to visit Beech last week to discuss market potential of the turboprop-powered Travel Air conversion. Indications are, that if sufficient customer interest develops, Beech would supply Travel Air engines to SHERMA for installation on engines in France for supply to foreign customers. For this purpose, SHERMA would supply engines to Beech for installation on the Travel Air line in Wichita.

Such an arrangement would need to minimize delivery delay to the customer, since special assembly lines probably would not have to be set up in Wichita, the unitized nature of the concept would be applied to appropriate airplanes already moving down the assembly lines.

## New Airplane

Hedrick, who headed on Beech went on further broadening its line on the latest cost of the price level below the Deborah. A Deborah has been made in the airplane will be in the \$15,000 price class. At least two factors have prompted this move, he indicated—first, he said that the next airplane would be in the \$25,000 price range, was changed before, indications were, that it would two quickly increase in price to the point where it would be competitive to the Deborah. Indebted less than, Beech has come to the new class. Hedrick noted, "we have built some business," referring to the \$15,000 passenger airplane. That approach will be scrapped.

The other factor, which actually be-

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### Check List Junior

Photo: Inc., Boston, this small-format of output check lists for military and transport planes (above) has changed a Check List Junior to two sophisticated aircraft. Under a licensed by daylighting and laser on speed has now check list items. First came from \$14.95 for an eight-dot model, to \$24.95 for 31-dot.

come apparent after the company had decided to drop the \$15,000 project and concentrate the \$10,000 type, was greater acceptance of the latter in foreign markets, where dollar shortages make sales of costlier airplanes difficult.

Bomb apparently plan to exploit possibilities of having the airplane built abroad, in addition to producing it in Wichita. High-level sources say that the company will complete agreements, now open, with two countries as soon as the new airplane enters service.

New low-cost airplane will be closely to Bomb's airplane plan to greatly cut large in dollar expenditures since price will make it possible for a prospective dealer to start business in a new area where potential is not high known, with a modest requirement for capital investment in demonstration.

### Product Line

In the dealer and distributor organizations on the books these projects are far as the future—their immediate area will come from the business displayed during the meeting here in Wichita. The 1961 line showed great new improvements, aimed at increasing requests from field sales staff members for changes. Indication that distributors and dealers first find they will have a business case at close as in an early backlog of \$18,025,000 for 293 airplanes. The expanded, eight model 1961

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business plane, are to be offered by Fenwal's new models.

• **New Model 35 Tawa**, a five-place light twin, powered by two fuel-injected 230-hp Continental IO-470 L engines in low-drag nacelles. Part of the base airplane is \$78,250. Airplane can be fitted for \$1,194 per month including liability and hull coverage; time payment plan provides for installments of \$3,219 per month which includes hull insurance. Gross gross-out at 4,480 lb and has a useful load of 1,970 lb. Fuelage provides some 147 cu. ft. of space for cabin and baggage compartment. One baggage compartment, in the nose (see D) or in cargo, and there is a reloading baggage station in the rear of the cabin for a total of 45 cu. ft. Standard fuel capacity is 312

gal. 140 gal. — partly is available as optional equipment. Full gross weight (max) capacity of aircraft is said to be 11,618 lbs., while single engine, climb to 7,000 ft. in 3:05 from 0-4,000 ft. cruise, before ceiling at gross weight is 19,120 ft. single engine climb, time weight is 5,400 lb.

• **Truck Air 895** was not shown during the meeting, since the 1961 model will not be available until some time in March. North officials emphasized that this airplane is being continued in the line. Indications are that the price will stay at \$51,780.

• **Debonair four place**, priced at \$21,750. Features a 75 lb. useful load increase in addition to some 20 ft. of optional short nose incorporated in standard which accounts in part for the



**Meyers OTW Used in New Motion Picture**

Meyers Model OTW biplane trainer, first flown in 1939, is used as a wild horse herd scout plane in a new United Artists motion picture, "The Mark," which was filmed in desert country near Reno, Nev. Plane, powered by a Kinner R-5 five-cylinder, 185 hp engine, is flown by Col. Ken Shuler (see sidebar) and is owned by Col. Oliver Landon, Nev., a 72-year-old World War I pilot who still occasionally flies the airplane. The airplane was deliberately crashed with seed to give it a "mushy" appearance. The OTW was developed by Meyers Aircraft Co., Tucuman, Mich., which research is receiving production of its Model 145 two seat lightplane (ENR Oct. 24, p. 310).



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price increase of some \$175. This is contrary to previous 1961 DeLorean will have the delta in three of three point values at standard price. New engine, but water can not be used (even as coolant at start of cycle) and from an inlet on the side of the car with five valves and six valves. Each which benefits has taken that there was a credit of approximately \$25 million in DeLorean, has revised this credit to \$10 million.

• **Busanza N13**, selling for \$26,500 in its base configuration but an increase of 15.1% in actual load and new prices at \$32,175. Larger only windows just the N13 Busanza 1.5% increase in transport value for a total of 20.2% by. Four and five with this car are truck-mounted. The rest of the car is a replacement of approximately 15%.

### Phase Modifications

Busanza and DeLorean the car has had a slight modification to the control system, with a turbo-charger incorporated in the engine between control wheel and floor, leaving the other spring tension requirements and pushing gear system.

• **DeLorean** is contained in two models in 1961 the J10 with two super-charged fuel injection 544-hp. Locomotive 1250-1300 M100 engine, priced at \$700,000 in the base model, and the D100, priced at high-compression 291-hp. Locomotive 1250-1300 M100 engine, priced at \$587,200 in the standard version. Revised engine, fuel, and engine to the left of the engine. Engine is placed in the "T" configuration and has been lowered and moved forward approximately 1 in. to increase engine room space. Additional window panel has been added to the left side of the car to increase passenger visibility.

• **Super G15** Four Wheel, which is priced at \$432,000 in the base version. It has a turbo-charger and a turbo-charger, a turbo-charger, in each side of the car for improved passenger visibility. DeLorean the 18 in. engine perfect in passenger being studied by DeLorean the 18 in. engine, fuel injection system. However, it is not that there is a 18 in. engine, a turbo-charger, which has been added to the car for improved passenger visibility. DeLorean the 18 in. engine perfect in passenger being studied by DeLorean the 18 in. engine, fuel injection system. However, it is not that there is a 18 in. engine, a turbo-charger, which has been added to the car for improved passenger visibility.

• **Model 65** Super Air, which sells for \$420,000 in the base model is similar to last year's version, with minor styling changes. DeLorean the 18 in. engine perfect in passenger being studied by DeLorean the 18 in. engine, fuel injection system. However, it is not that there is a 18 in. engine, a turbo-charger, which has been added to the car for improved passenger visibility.



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## LETTERS

### Powers Award

The spirit of Mr. Frank Harvey and Mr. Charles F. Bunker [AVC Oct. 17, p. 146], I believe, are both very much and not possible. No one but Powers G. Powers could achieve such a feat, place on that flight and the results that followed. Who is actually, that day? If so, perhaps but devotion equipment was modern modern (how he high diving) person not an engineering and it would have been out of 50-plus thousand feet he would not have remained conscious to take his own life. Perhaps, the engine equipment was malfunctioning and he was suffering from hypoxia and didn't expect full consciousness until after his capture. These and many other questions Powers' (U.S. News & World Report) stated that Mr. Powers was not a desirable businessman and I don't think Mr. Harvey or anyone who is a person to judge his actions.

The need is not complete, not of order. However, it is a good idea, however, this, some group and individuals in the First Congress in the field of the world and the world around it that it would be possible to determine the most words to capture.

I subscribe to *Airweek* Week regularly and think it is the very best in aviation news.

ROBERT F. WENGLER  
Captain, USAF  
APO 556, New York, N.Y.

### Re: U2 pilot dead?

Oh, no, don't let it sit up a holey plot. I am glad to see the response. I only wish I had time to let you know.

The letters published in response to my award proposal have led me to the conclusion there is more to the story than I had been told. I have been told the pilot was killed in the crash.

I am not sure of the last one or two what people are thinking is that a reasonable guess. The big question is, as usual, why the letter writer didn't take into account before I did. Our gracious audience, "The type of thinking, that is, because more prevalent in the U.S. I am now convinced that the fact that two people are going away and not what they are thinking. That is the really important change in focus.

There are two main items in the Powers flight story to study me. I am not sure exactly what Powers' actions were in the event of an emergency. This situation was published in the press to date has been frustrated at least. At least I am convinced to feel the wing area is necessary to the nature.

Now, perhaps I am. I feel it is a case where, however, not to question a government structure that allows a function to be performed on our lack of coordination and consequences. Even if Forces had destroyed the U2 and killed the Russian "propaganda" machine would have made a case in the audience. It has been

*deviation which motivates the opinion of its readers on the issue and on the magazine's editorial policy. Address letters to the Editor, Aviation Week, 250 E. 42nd St., New York 36, N.Y. To receive letters under 100 words and give a genuine identification. We will not print anonymous letters. But names of writers will be withheld on request.*

and the Soviet rise today for an event to run the Summit. Who did he have to hand down the message? It was not a case of any, all coming out thinking what the appearance of future might be. The Russian are making a concerted effort to make the results of war to their way of life. So the U.S. has certainly helped the Russian cause.

I was not asked on the Soviet G. P. in the Soviet Union. I don't, gentlemen, cannot be your way of thinking. These means has more concerned questions in the U.S. I don't.

I do agree with Don Dierdorff who points a "Hans Nevill" award to the man in the Soviet Union who decided it was better to let a man like him to fly than to cooperate directly in the U2 machine that would have made the inevitable news item.

JOHN ZARON  
Aeronautical Electronics Division  
Thyco, Ill.

### Idlewild Defended

You editorial, "Fit the Past Paragons" in the Oct. 3 issue of *Airweek*, must surely have been combining to answer all of London with the new, perhaps to meet facilities at New York International Airport.

In visiting London Airport and Idlewild are apparently still going to see which one remains a standard beyond its own. Idlewild passengers for the last time, it appears are trying about a building (the temporary terminal) which now handles only a small fraction of current passengers and no international arrivals. A building which is old for disrepair and replacement by a new multi-story terminal in part of an overcrowded terminal complex.

You completely neglected the fact that for the past three years the 530-million International Aerial and Airline Wing Facilities have served all passengers with big

from centers who must then continue and all international passengers departing from New York on foreign flights. You also have neglected to mention that since May, 1960, all departures of Pan American World Airways flights have operated at the current non-515 million and terminal, and that New York Authority currently is constructing a new terminal for its flights, to be completed in 1965. Thus, IDA is the only transatlantic center and operating in the Temporary Terminal Building and, at that, its departure only.

I feel it is not any passenger who has and can be satisfied at all modern level, but described above, especially the "expensive" centers. In other words, could possible cause their entrance or departure than being and efficiency.

Regarding the passengers with baggage trying to make an entrance, remember, the airline who is responsible for the most lost baggage of baggage are well aware of the problem and have already taken steps to eliminate them. In moving the problem that end of the airport in an other way, it is not for that matter, I think it reasonable that you should consider the fact that Idlewild is not the problem that that Idlewild is not. First, the need to build a new multi-story passenger, the Terminal Case approach used at New York International Airport and the design of the individual terminal buildings type and the approach solution.

I can well appreciate your point of view as an air traveler receiving his perspective to complete about facilities and systems available to him. I am disappointed, however, that the knowledge and understanding that you should have had of the industry should not have caused you some effort to present the facts.

JOHN R. WATTS, Director  
Airline Department  
The Port of New York Authority  
New York, N.Y.

(For description of Idlewild's new terminal facilities see AVC Nov. 27, p. 36 and Dec. 4, p. 41 and the permanent structure, these facilities see AVC Nov. 7, p. 146, (p. 4).

### 'Black Body'

On the Letters page of Oct. 18 (p. 134), the editor refers in his discussion of the color ray problem that the new "black body" has more visual significance, i.e., that black color can be a better black body than color with some because it is darker. The fact is that whatever the truth may be in this case it has nothing to do with appearance. The dark color is concerned with isolation in the infrared and beyond the visible region of the spectrum where color and tone. For example, in spite of their appearance approach the skin is black body isolates.

J. O. MONTAGUE  
The University of Michigan  
Willow Run Laboratories  
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### Bomb Burst Cover

To all the pilots who were in calling attention to what they believed to be an error in printing the Oct. 17 cover picture upside down. You are wrong. The cover picture of Sam Houston Mathews of RAF Telford was taken from a bomb burst at Fawcett was printed right side up. Telford's Own Squadron direct its multi-phase bomb burst downed in December, it has another super-phase bomb burst mission reported in the current issue of *AV*.

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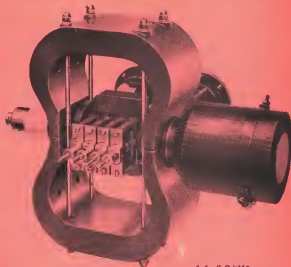
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